ENGINEERING NEWS-RECORD

SEPTEMBER 20, 1945

In This Issue

SURFACE WATER DEVELOPMENT ON GUAM

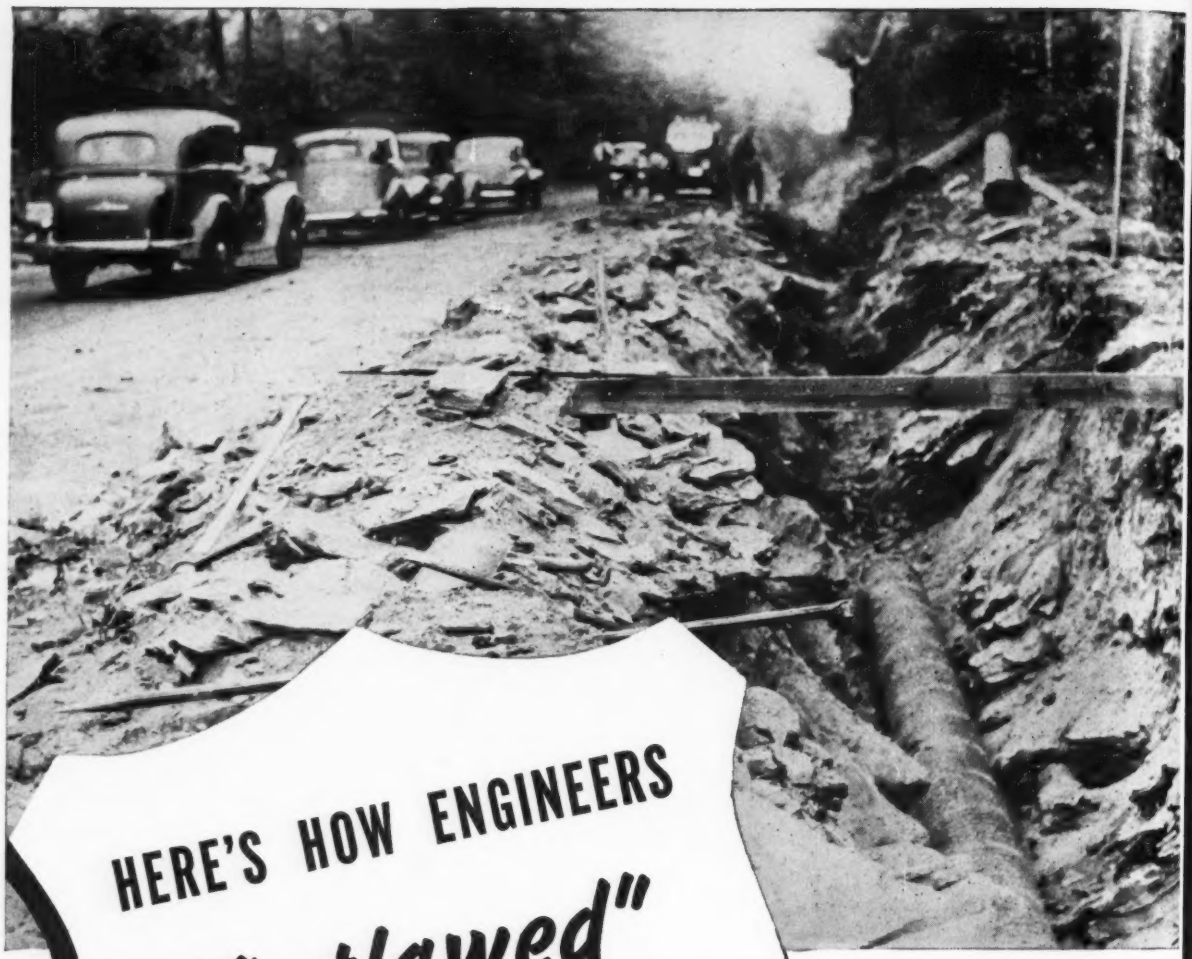
•

FLEXIBLE CONCRETE MAT FOR RIVER REVETMENT

•

EXPERIENCES WITH STATE BUILDING CODES

Traveling stiffleg derricks, of special design, mounted on high towers facilitated steel erection for the world's largest wind tunnel at Moffett Field, Calif.



HERE'S HOW ENGINEERS "Outlawed" PAVEMENT BREAKUPS

This state's highway subdrainage program was speeded and simplified by use of long lengths of sturdy, flexible perforated pipe. Begun in 1940, the work continues, and pays dividends in firm, smooth, pavements that require little maintenance.

★ ★ ★

Until 1940, pavement breakups were as "reg'lar as groundhog day" each spring on certain New England highways. Then state engineers went into action with a thorough subdrainage program. Today that work is paying off in firm, smooth pavements, less maintenance work, reduced costs. A vital factor was—and is—perforated metal pipe that intercepts ground water in the trouble spots. They keep pavement foundations stable and firm.

You can "outlaw" costly breakups the same way with ARMCO Perforated Pipe. Installation is easy and fast, and costs are low—thanks to the long pipe lengths, fewer joints, light weight, and freedom from breakage. Once in the ground, ARMCO Perforated Pipe has the flexible strength needed to resist traffic weight and impact, vibration and disjointing. Perforations instead of open joints reduce the hazards of clogging.

Remember that good drainage is costly only when omitted. Write us for literature on Designed Subdrainage. Armco Drainage Products Association, 155 Curtis St., Middletown, Ohio.

ARMCO Perforated Pipe

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Shipbuilding, Irrigation, Canals, Railroads

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WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Publisher*

Vol. 135 SEPTEMBER 20, 1945 No. 12

COMING NEXT

• T-beam deck slabs, weighing 110 tons, are precast in 40-ft. sections for a long reinforced-concrete slab-and-girder bridge, which is being erected by the Virginia Department of Highways. The sections are manufactured at a central yard, loaded on barges and floated to the bridge site, where water is pumped into the scow to lower the slabs into place. By this method the use of form lumber has been reduced to a minimum, need for extensive falsework eliminated and concrete is being placed on a production line basis. The project will be described in the Oct. 4 issue.

• Sanitary engineers will find three articles in the Oct. 4 issue of special interest. They are: A proposed plan for sludge preheating in a 120-mgd. capacity plant; a review of sewage disposal problems in the London metropolitan area during two wars, and how a Navy Seabee battalion built a 3-mi. outfall sewer across a tide-flooded barrier reef on Guam.

• Incorporated in the design and construction of a circular reservoir of 4½-mg. capacity, recently completed at Great Falls, Mont., were new concepts, involving a two-way prestressing technique. This tank has vertical prestressed rods in addition to the customary horizontal bands of prestressed hoops. Design data and construction procedure will be outlined in *ENR* for Oct. 4.

LOOKING AHEAD

• Snow removal and ice control on state highway systems constitute an expensive public service—one which is taken for granted when it is good, yet quickly criticized when it is not. To help those charged with the responsibility of keeping our highways open this winter *ENR* will present in the Nov. 1 issue a brief but highly informative description of current practices being employed by twelve state highway departments in widely separated sections of the snow belt.

• Fortunately, none of the famous bridges in Paris were damaged during the war, however, French engineers and contractors are faced with a stupendous bridge reconstruction job along the Seine and Marne. This rebuilding program, and several new spans of unique design—planned before the war and soon to be erected—will be described in an early issue.

	PAGE
Contents Page	85
Comment and Discussion	92
Editorials	94
Erecting Steel for Tornado in a Tunnel.....G. R. LUNT	
Experience With State Building Codes	101
Irrigation Program Planned by Bolivia	104
Piles Jetted by Three-Lead Driver	105
State Laws Ease Surplus Purchasing	106
Clearing Snow at a Northern Airbase	107
Raising Ross Dam to 475-Ft. Height	112
Surface Water Supplies on Guam.....G. H. ABPLANALP	116
Higher Water Rates Beyond City Limits	121
British Construction Plant Record System....H. W. RICHARDSON	122
Marines Turn Bridge Builders	123
New Method of Revetting Old Man River.....A. B. PICKETT	124
Unit Prices	130
Men and Jobs	134
Elections and Activities	138
New Aids to the Constructor	144
Manufacturers' Activities	152
Manufacturers' Publications	158
Construction Reports	203

Number of copies of this issue printed: 38,099

DO YOU WANT AN INDEX?

Due to the paper shortage, no index for volume No. 134 (Jan.-July, 1945) will be issued except to subscribers who ask for it. If you want a copy of the index please send in the coupon below.

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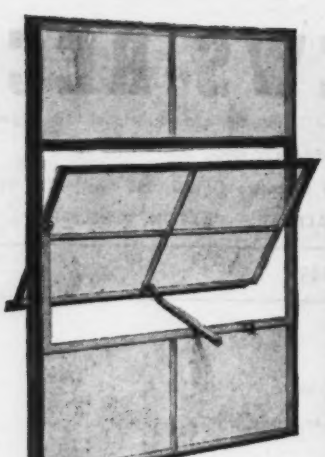

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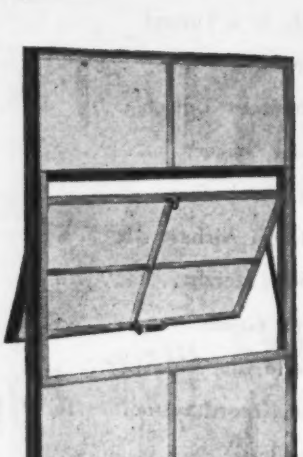

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Write for our new folder (A-611) giving complete details and types and sizes. Our experienced engineers will be glad to help plan your use of windows to maximum daylight and ventilation.

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Truscon Pivoted and Commercial Projected Steel Windows in Ohio Steel Foundry Company Building, Lima, Ohio.

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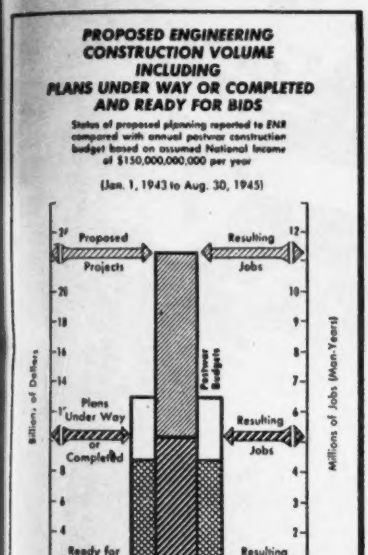
Future Construction Planning Report

AT THE WAR'S END the reservoir of identified and recorded engineering projects proposed for future construction totaled $22,532,000,000 as reported to *Engineering News-Record* in the 32 months from January 1943 through August 1945. Almost 46 percent of the proposed backlog, $10,295,535,000, has engineering plans underway or completed.


PROPOSED ENGINEERING CONSTRUCTION VOLUME INCLUDING PLANS UNDER WAY OR COMPLETED AND READY FOR BIDS
Status of proposed planning reported to ENR compared with annual postwar construction budget based on assumed National Income of $150,000,000,000 per year
(Jan. 1, 1943 to Aug. 30, 1945)
Billions of Dollars
Millions of Jobs (Man-Years)
Proposed Projects
Resulting Jobs
Plans Under Way or Completed
Postwar Budgets
Resulting Jobs
Ready for Bids
Resulting Jobs
(Assuming that $1 of construction volume produces 1 man-hour of labor, ½ on site)

Accelerated by the cessation of hostilities, $25,122,000 worth of proposed projects advanced from the future construction reservoir to active work during August, bringing the total to date to $46,538,000 for projects transferred from the reserve to the active stage. Of this total, $37,040,000, or 80 percent of the volume proposed, was in the planning stage prior to elevation to active status.

During the five weeks of August, $659,365,000 in new proposed projects and $578,557,000 in projects with plans under way or completed were added to the reservoir of future engineering construction. The proposed project total for the month is 6 percent below the 32-month average of $704,000,000, but the planning total for August is 79 percent above the monthly average for the period from January 1943 through August 1945, $322,000,000.

In the future project reservoir at the end of August, there was $858,078,000 in construction projects ready for bids, with all land, legal and financing obstacles overcome. In addition, projects valued at $559,605,000 have planning completed but are held up by lack of financing, and $920,165,000 worth of projects have financing available but design plans still unfinished.

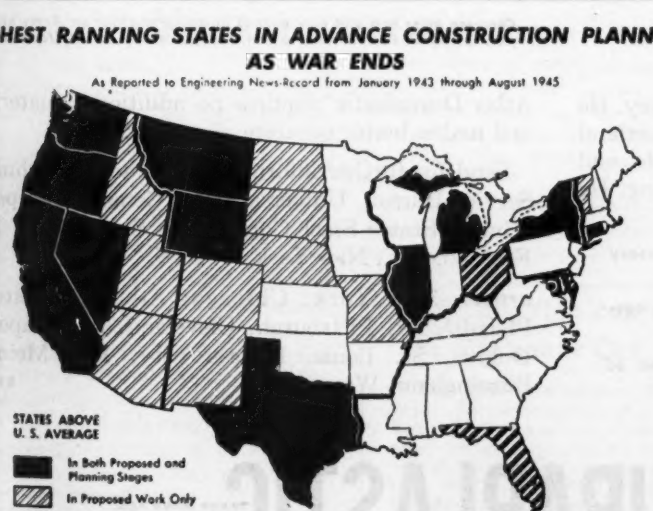
The ready-for-bids volume is equivalent to an investment of $6.51 for each person in the country (1940 census). The per capita investment for planning stage projects is $78.20, and that for proposed projects is $171.00.

Fifteen states and the District of Columbia exceed the $78.20 per capita plans stage average, the inclusion of Wyoming in the state list accounting for the only change from the preceding month.

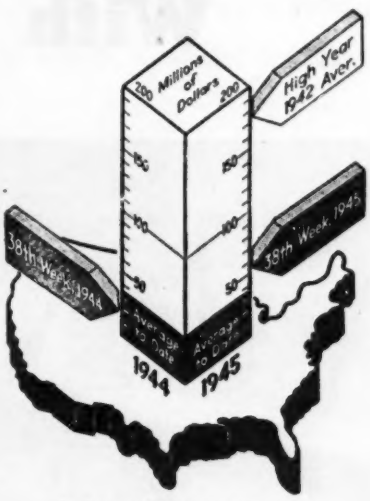
(*Proposed Project Reports, page* 162)

HIGHEST RANKING STATES IN ADVANCE CONSTRUCTION PLANNING AS WAR ENDS

As Reported to Engineering News-Record from January 1943 through August 1945



CONSTRUCTION ACTIVITY



As Reported This Week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of Sept. 20 1945	Cumulative 1945 (38 wk.)	Cumulative 1944 (38 wk.)
Federal	$7,171	$670,556	$877,943
State & Mun..	7,797	244,335	184,844
Total Public..	$14,968	$914,891	$1,062,787
Total Private.	40,220	492,546	285,929
U. S. Total...	**$55,188**	**$1,407,437**	**$1,348,716**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of Work	Dollar Volume (Thousands) This Week	Cumulative 1945 (38 wk.)	Cumulative 1944 (38 wk.)
Waterworks ...	$200	$39,353	$23,465
Sewerage	424	23,172	23,227
Bridges	743	23,700	11,010
Highways	4,565	160,238	158,252
Earthwork, Waterways.....	1,186	37,008	51,008
Buildings, Public	2,547	410,490	499,224
Industrial ...	21,030	308,205	130,535
Commercial .	9,069	118,944	113,988
Unclassified ...	15,424	286,327	338,007

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1945 38 wk.	Cumulative 1944 38 wk.
NON-FEDERAL	$576,935	$346,555
Corporate Securities.	120,571	96,045
State and Municipal.	292,764	109,720
RFC Loans	24,600	57,790
REA Loans	60,000	20,000
Fed. Aid, Highway..	79,000	63,000
FEDERAL	$1,049,898	$1,263,800
**Total Capital ..... **	**$1,626,833**	**$1,610,355**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	Sept. '45	309.28	148.67
Building Cost	Sept. '45	240.07	129.77
Volume	Aug. '45	119	52

With only one pass!

Concrete after first and only pass *of finishing machine on Army airport paving project. L. G. Defelice & Son, Inc., contractor, North Haven, Conn.*

Here's how a contractor saved time and money. He used Atlas Duraplastic, the air-entraining portland cement that makes concrete more workable and practically eliminates segregation and bleeding. He reports—

Only one pass of the screeding machine was necessary to produce a desirable surface for finishing.

Finishers floated, edged and jointed the concrete surface immediately behind the screeding operation.

This saved time and expense at the termination of each day's concreting.

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Send for further information. Write to Technical Service Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 135 East 42nd St., New York 17, N. Y.

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The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • SEPTEMBER 20, 1945 • VOLUME 135 • NUMBER 12

Private building upswing promises high record year

Much private construction reported already under way as industry expands—Expect 1945 building total to compare with four biggest construction years

In swift confirmation of predictions of a substantial private construction boom, manufacturers, industrialists and builders this week were reporting details on work already under way or soon to start that has already made 1945 one of the five biggest years in recorded construction history.

As totalled by *Engineering News-Record's* Business News department, the value of 1945 industrial construction for the first 37 weeks totals $287,000,000—already greater than the full-year total for eleven of the last 20 years.

In the past 6 weeks industrial contracts have averaged $12,000,000 per week, sharply above a $7,000,000 per week rate during the first half of the current year.

News-Record's statisticians expect the total for 1945 to reach $467,000,000. This figure would be only $127,000,000 below the total for 1940—all-time high construction year. Other highest construction years were 1929, 1941 and 1937 in that order.

The Department of Commerce, in a recent survey, estimated that private industry would spend a total of six billion dollars for reconstruction, reconversion and new structures and equipment in the early postwar years (*ENR*, Aug. 9, vol. p. 145). *Engineering News-Record's* own construction data backed the government survey although this journal's estimates were considerably more conservative.

Almost immediate relaxation of federal control over construction and materials (*ENR*, Aug. 16, vol. p. 195), plus concurrent releases of controls on supplies and termination of war contracts, are credited in part for the spurt in construction activity.

Among the major projects on which reports have been received of work actually under way are the following:

Preliminary work on the new $10,000,000 "Electronics Park" at Liverpool, a suburb of Syracuse, N. Y., for the General Electric Co., is now well advanced, and actual building operations are expected to begin immediately, according to a recent statement issued by W. R. G. Baker, vice president of the company.

Ten buildings to be constructed on a 155-acre site will provide total floor space in excess of 1,000,000 sq.ft. Grading of the site, laying of service tracks and water mains, sewers, underground electrical ducts and other services are almost completed. The Walsh Construction Co. of New York City has been awarded a general contract for erection of the structures.

Chemical plant construction

E. I. du Pont de Nemours & Co. of Wilmington, Del., has announced that work is now under way on the first unit of a $50,000,000 development near La Porte, Tex., where the company expects to produce chemical products. First unit of the project will be a $2,500,000 plant for quantity production of livestock remedies, fungicides, organic sulphur seed and turf disinfectants as well as other crop-saving chemicals. The new plant is expected to be in operation early next year.

In California, a syndicate headed by R. S. Diller, of Los Angeles, announced plans for the immediate erection of 850 homes on a 180-acre site on the city's outskirts. This project may call for the expenditure of $6,000,000 for the whole

(*Continued on p.* 86)

Foreign governments push building

While the United States forged ahead with its plans for major post-war construction activities, other governments throughout the world last week were also activating huge programs.

Included in such work reported last week was an announcement by the government of the Union of South Africa that it plans to construct an irrigation canal at a cost of about 40 million dollars, to transport water from the Orange River at Bothulio in the Orange Free State to the Brak River, 50 miles distant.

The South African government also announced that its Department of Welfare and Demobilization has started construction of some 6,000 houses for returning war veterans, the entire project to be completed within 18 months. Houses built under the program will be rented for $25 to $35 per month.

In Mexico, President Avila Camacho announced that the Mexican government expects to spend more than $14,000,000 during 1946 to finish the last stretch of the Inter-American highway in Mexico. The president said that the highway has been completed in Mexico except for a section in the region of the Tehuantepec Isthmus.

Canadian work reported included a $17,567,000 construction program for Edmonton, Alta., which would include paving, new schools, bridges, drainage, airport and other work.

At Vancouver, B. C., the city plans to implement a $60,000,000 ten-year development program; major item in the latter would be construction of a new waterfront viaduct with entries at Granville, Cambie and Main streets, at a cost of $2,500,000.

WPB building controls to disappear Oct. 15

The War Production Board Sept. 18 announced that the General Controls on Construction, Order L-41, would be revoked October 15. At the same time the Office of War Mobilization and Reconversion announced a six-point program to speed expansion of the construction industry. Details will be given in next week's issue.

Huge federal construction now ready; states, cities add to spending plans

President's request for release of federal-aid money spurs activity in national bureaus, local governments seeking building start

Spurred by last week's Presidential message calling for release of federal funds to aid local governmental units in implementing postwar construction plans, governmental agencies last week readied final specifications for a total federal public construction program estimated at 2½ billion dollars. This will provide an important supplement to state and municipal work now getting underway.

Work on many of the projects can begin this fall, now that all restrictions of WPB Order L-41 are to be lifted on Oct. 15.

Flood control and irrigation

Some of the work planned comes under the following headings:

The three billion dollar three-year federal aid road program, matching plans for which have been completed and approved by most of the 48 states; construction work on some $1,158,000,000 of reclamation and irrigation projects, $750,000,000 worth of flood control and rivers and harbors projects; nearly one billion dollars in public works for states, counties and cities. (*ENR* Sept 13, vol. p. 335).

As reported by *ENR* correspondents, some of the work now waiting for the government's go-ahead signal includes: Plans for postwar navigation and flood control work on the Monongahela, Allegheny and tributary streams around Pittsburgh, Pa., plans for a four million dollar dam across the San Jacinto river to provide water for industrial use and drinking purposes for Houston, Tex.; $100,000,000 worth of flood control and protection projects in the Ohio Valley to include continuation on the Wilson Creek Dam in the Cumberland Valley in Kentucky and the Mill Creek barrier dam protecting one of Cincinnati's industrial sections.

Much highway work

With highway traffic already approaching prewar standards, according to the Federal Works Agency which noted increases of from 21 to 36 percent throughout the nation, state highway departments continue their plans for expanding road networks. (*ENR* Sept. 13, vol. p. 349).

In Maryland, Governor O'Conor proposed a new bridge over the Severn River, about three-quarter mile north of the present Richey Highway Bridge leading into Annapolis, to cost a total of about $8,000,000. The State of Kentucky plans to spend $4,000,000 on federal-aid system highways and about $2,000,000 on farm-to-market roads, rural mail and bus routes and principal roads in urban areas.

Municipalities and other governmental units also added to the fast-growing list of public projects.

In Illinois, the Department of Public Welfare announced that work on a new diagnostic hospital had started. At Dallas, Tex., the city council voted to finance preliminary stages of a proposed $35,000,000 five-year building program for the city, by increasing the basis for tax assessments from 53 to 65 percent on true property values. The program calls for street improvements, paving, storm sewers, airport improvements, school structures, public buildings and parks and street lighting.

Also in Maryland, estimates for the state showed plans for buildings to cost about $229,000,000.

Mobile, Ala., plans a $350,000 football stadium.

Rochester, New York, mapped a $10,000,000 program that envisions a new city hall, a war memorial auditorium and recreation center, and several major sewer improvement plans.

The Fresno County, Cal., Board of Supervisors approved plans for a $5,365,333 improvement program, with major emphasis on school construction.

Shreveport, La., planned a new veterans' hospital; a $3,000,000 river-bank stabilization program along the Red River; school improvements and $6,000,000 of other public works.

Louisville, Ky., said it had a $12,000,000 backlog of public and private work ready when funds and materials are available.

Building upswing promises high year

(*Continued from p.* 85)

At Richmond, Va., the Virginia Electric & Power Co. and the Appalachian Electric Power Co. said work is under way on a $10,000,000 project to provide new electric lines.

The International Harvester Co. said that construction had started on a new plant at Memphis, Tenn., where the company plans to erect buildings to cover a 259-acre area for the manufacture of farm machinery. The new plant, which will cost a total of $3,000,000, will provide about 1,000,000 sq.ft. of floor space.

The Allis-Chalmers Mfg. Co. awarded a $6,000,000 contract to the Charles W. Cole Engineering Co. of South Bend, Ind., for reconstruction and new construction at the company's LaPorte, Ind. plant.

Sears, Roebuck & Co., Chicago, Ill., said that work was under way on a $7,750,000 building to house its store at Houston, Tex. The structure will be two stories with full basement. W. S. Bellows Construction Co., Houston, holds the contract on a cost-plus basis.

Although no cost figures were given, the Standard Oil Co. of Indiana states that work on its new research laboratories at Hammond, Ind., is under way. Holabird & Root, Chicago architects, have been engaged for the work.

In Texas, the United Gas Pipe Line Co. of Shreveport, La., announced start of work on a 143-mile 24-in. natural gas pipeline carrier to extend from Carthage, Tex., to the vicinity of Monroe, La. The cost of the project is estimated at $7,150,000.

At Pittsburgh, Pa., the Phelps Dodge Copper Products Corp. announced that work had started on a new 31-acre rod, wire and cable plant at Fort Wayne, Ind., to cost $4,500,000.

Under the heading of private projects nearing the active construction phase were the following:

A plant for the construction of prefabricated homes on a production line basis will be built by U. S. Steel at New Albany, Ind., to house the company's recently-acquired subsidiary, Gunnison Homes, Inc. The plant will cost about $1,000,000.

In Cincinnati, O., Thomas Emery's Sons, Inc., operators, announced plans for an $8,000,000 hotel building and a 7-story department store building. Skidmore, Owen & Merrill of New York and Chicago were awarded the contract.

The Reynolds Metals Co. of Richmond, Va. announce purchase of 80,000 sq.ft. of land in Cambridge, Va. for construction of a million dollar laboratory for research in aluminum alloys.

General Motors Corp. announce plans for erection of a $6,580,000 plant at Kansas City, Mo., for the assembly of Buick, Oldsmobile and Pontiac cars. A 317-acre site for the plant was purchased in May of this year.

Monsanto Chemical Co. of St. Louis, Mo., said it would spend $48,400,000 on 151 construction and expansion projects as part of its peacetime program.

At Weirton, W. Va., the Continental Can Co. said it had acquired a 146-acre site on which it intends to build a large can making plant.

V. E. Gunlock, new chief of Chicago's subways

Virgil E. Gunlock, formerly chief engineer of the Department of Subways and Superhighways, Chicago, has been appointed commissioner of the department by Mayor Edward J. Kelly. He succeeds Philip Harrington who resigned recently to become chairman of the Board of the Chicago Transit Authority.

V. E. Gunlock

As commissioner, Mr. Gunlock will direct the department's postwar construction program. Major projects scheduled for early construction include completion of the Dearborn-Lake-Milwaukee Avenue subway at a cost of $10,000,000, and construction of the 8-mile long, 8-lane West Superhighway at an estimated cost of $46,000,000.

Following his graduation in civil engineering University of Illinois, in 1927, Mr. Gunlock joined the technical staff of the Chicago Sanitary District.

Three huge blimp hangars destroyed in 130 mph. Florida hurricane

Timber structures at Richmond Naval Air Station near Miami fall on planes and burn. Loss estimated at $30-40 million

Three of the world's largest timber structures—naval lighter-than-air hangars 171 ft. high, 1,058 ft. long with a clear inside span of 237 ft.—failed Saturday night in a tropical hurricane, when wind velocities reached an estimated 130 mph.

The hangars, all at the Richmond Naval Air Station 30 miles south of Miami, Fla., housed 25 blimps and 366 planes.

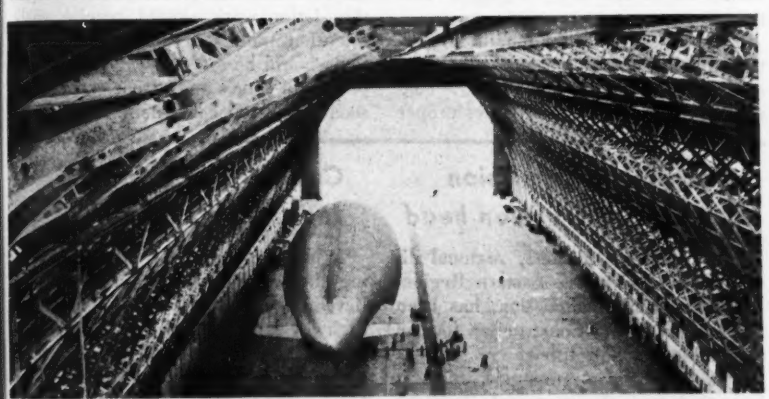
Falling structures smashed the planes and started fires that it was found impossible to control. Value of the hangars and aircraft was estimated in news reports at $30 to $40 million. Original cost of the hangars was $2,800,000 each.

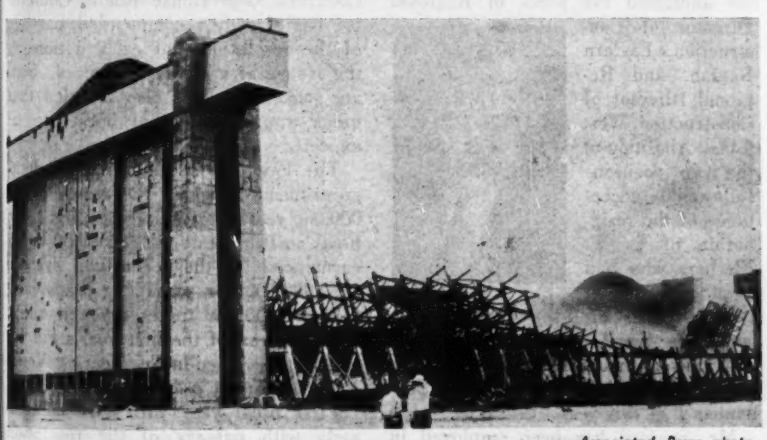
The timber hangars were catenary arch-shaped structures each containing about 3,000,000 b. ft. of which 750,000 b. ft. were heavy timbers, 3 x 12s to 6 x 14s, in the arches. (*ENR* Oct. 14, 1942 p. 576). Two of the hangars were parallel and about 80 ft. apart, with their longitudinal axes roughly east and west. Third hangar was about half a mile away, with its axis roughly north and south.

All three structures were built as a joint venture of Ivy H. Smith Co., S. S. Jacobs Co., and Langston Construction Co. whose method of construction is described in *ENR* Sept. 23, 1943 p. 463. Timber for the structures was pressure treated with a mixture of ammonium and boron to make the wood as nearly flameproof as possible. Information is not yet available on the effect of the flameproofing but the structures apparently were blown down before the fires started.

Somewhat similar failures occurred during erection of the same type of hangar at a naval air base in California. There winds of 85 mph., with gusts of higher velocity, blew down several of the 51 arches of a hangar. At a later date movement of rolling falsework, due to wind, pulled down some additional arches. (*ENR* Feb. 25, 1943, vol. p. 272).

The big hangars were designed and their erection supervised by the Bureau of Yards and Docks of the Navy. A total of 17 of them were built at shore locations throughout the country and have satisfactorily housed blimps used for patrol against submarine activity along the coasts. Also in the path of the present storm are hangars at Elizabeth City, N. C., and Lakehurst, N. J.





Associated Press photo

Timber blimp hangars at Richmond Naval Air Station near Miami before and after the huge structures were struck by hurricane and fire on Sept. 15. Three hangars and nearly 400 aircraft were destroyed. One fatality is reported.

LAKE OKEECHOBEE ESCAPES

Levees built around the shores of Lake Okeechobee in south-central Florida to protect the surrounding area from storm tides raised by hurricane winds functioned satisfactorily during the storm. This is the first major test of these protective measures, built following a storm late in 1928 when about 2,000 people lost their lives as the hurricane swept water out of the lake across the low-lying farms and town at the head of the Everglades. In the 1928 storm the wind tide raised the water from El. 16.4 to 29.5. Fifty-one miles of levees now protect the southern shore, being equipped with hurricane gates at the points where canals to the Everglades leave the lake. (*ENR* Aug. 16, 1934, vol. p. 195.)

The Florida State Road Department reported that the Overseas Highway escaped the full hurricane force.

Construction industry problems cited by Senate Small Business Committee

Lack of planning, manpower and materials seen as three big immediate problems—Other matters also require solution

Government and the construction industry must solve problems involving lack of trained manpower, lack of construction plans, and shortage of materials, if an immediate civilian construction rise is to be effective, according to the special Small Business Committee of the Senate, in a 22-page report issued Sept. 12, giving its findings with respect to the construction industry.

The committee found that construction, including maintenance and repair work, can provide employment for over four million on-site workers during peak months. With current prices, this employment was seen as calling for an annual volume of $15.5 billion of new construction or about $20 billion when maintenance and repair are included.

"It has frequently been pointed out that construction has never expanded in volume by more than $1,700,000,000 or employment by more than 300,000 in any single peacetime year. But in 1941, under wartime conditions, employment increased by more than 600,000, in volume by more than $3,500,000,000.

Lack of plans big problem

First of the three major problems now facing the industry is lack of sufficient plans to permit extensive construction to get under way immediately. Solution of this problem, the committee said, calls for closer coordination between governmental units and private agencies than is now apparent.

In addition, a clear statement of the federal policy regarding construction is believed necessary.

The limited availability of some building materials and equipment is the second immediate problem to be overcome before large scale construction can proceed. Although the recent relaxation of construction controls was beneficial, the committee criticized the Office of War Mobilization and Reconversion for failing to facilitate resumption of large-scale manufacture of building products and supplies.

Obtaining adequate and satisfactorily trained manpower was cited as the third major immediate problem of the industry. The committee stressed that labor unions must change their work rules and increase apprenticeship training to add to the ranks of skilled craftsmen. In addition, much other work is considered necessary to speed up apprenticeship training.

Seven other major problems must be given attention to assure a large volume of construction for the first postwar years, according to the report. First of these problems is the need to evaluate the desired role of construction in the postwar economy.

Many future problems

"If the construction industry is to carry its share of postwar full employment, private industry and Government will have to cooperate either to curtail excessive activity or to bolster up volume to prevent unemployment," the committee said. Rather than attempting to determine how this could be done, the Senate group listed a number of questions that should be answered, including whether or not the federal government should attempt to stabilize construction by controlling the flow of public works so as to balance out the variations in the flow of private contracts.

The proper role of the federal government in the construction industry is another major problem. This work is considered to include not only proper programming and budgeting of needed construction, but also revision of federal taxes to make improvements profitable, rather than to encourage the continued use of obsolete structures. It is also considered vital to determine what steps can be taken by the federal government to coordinate the policies of credit organizations lending money for construction projects.

Since inadequate knowledge of markets for construction has been named as one reason for violent fluctuations in building activity, setting up adequate facilities for accurate market analysis was listed as a problem for the future. The federal government must soon decide what share it is to have in this work, the committee reported.

More research needed

The committee considered it feasible to expand the present research facilities of the Federal Works Agency, the Bureau of Standards and the Forest Products Laboratory, but felt that this should be done only after the government's role had been evaluated.

How best to eliminate local building practices restricting construction was listed as another task of the industry, as was that of avoiding violent shifts in employment. The committee felt that this latter work should receive early attention, and that serious consideration should be given to the possibilities of annual wages and extension of social security for all construction workers.

Maritime Commission names construction head

L. R. Sanford, formerly regional director of construction, Eastern Region, U. S. Maritime Commission, has been named Director of Construction for the commission, a new title.

The commission announced that it has abolished the posts of Regional Director of Construction, Eastern Region, and Regional Director of Construction, West Coast. Abolition of the two positions followed acceptance of the resignation of C. W. Flesher, who had been director of the West Coast office since April, 1942. Mr. Flesher, with the Maritime Commission since November 1938, resigned effective September 1 of this year.

L. R. Sanford

Mr. Sanford has been employed in various capacities by the Maritime Commission and predecessor organizations since its establishment.

Congress to release federal road funds

A joint resolution (HCR 81) declaring the war emergency sufficiently relieved to permit release of Federal-aid highway funds provided in the Federal-aid Highway Act of 1944 (*ENR*, Sept. 13, p. 335) has been introduced in Congress. The House Roads Committee has already recommended passage of the resolution and early action by the House as a whole is assured. Senate spokesmen have also revealed that quick approval by that body can be expected.

The 1944 bill authorizes the federal government to grant the states $500,000,000 yearly for each of the first three fiscal postwar years, $225,000,000 being earmarked for the federal-aid system, $150,000,000 for secondary roads, and $125,000,000 for routes through cities. A breakdown of the first year's aid for each state is given in *Engineering News-Record* Jan. 18, p. 88.

First fiscal year will start immediately with passage of the resolution and the second fiscal year will begin July 1, 1946, which will result in more than $1 billion of federal help.

O. F. Sieder appointed vice-pres. of Ferguson Co.

Otto F. Sieder, formerly chief of the industrial construction division in the office of the Chief of Engineers, Washington, D. C. has been named vice-president and general manager of The H. K. Ferguson Co.

During his five years with the War Department, Mr. Sieder had charge of the design and construction of all munition plants for the Ordnance Department and Chemical Warfare Service. This program entailed expenditure of almost $6,000,000,000 and the construction of 260 separate plants. In recognition of this service, Secretary of War Stimson conferred upon him the Exceptional Civilian Service Award.

Mr. Sieder is a civil engineer graduate of Lafayette College. Early in his career he served with Purdy & Henderson, Westinghouse, Church Kerr & Co., and the American Bridge Co., and prior to his connection with the War Department he was a consulting engineer in New York City.

For 20 years he was vice president and chief engineer of Levering & Garrigues Co., New York, and supervised design and construction of the steel work in many large structures. He remained in charge of all operations for this firm until it was purchased by Bethlehem Steel Co.

British cancel orders for houses designed and prefabricated in U. S.

Only 10,000 units of a 27,000 order will be accepted now that lend-lease is terminated—American prefabricators criticized the design made by Federal Public Housing Authority

American prefabricated houses—at least the temporary type designed and built according to Federal Public Housing Authority specifications—have not won sufficient favor with the British for them to make outright purchases, now that lend-lease agreements have been terminated.

Some observers drew this conclusion from the announcement last week that Great Britain would accept only 10,000 of 27,000 units scheduled for production under a lend-lease arrangement made earlier this year.

Since last March some 45 contractors in the United States have been engaged in the construction of these houses, average unit cost of which is $1,310. The entire order of 27,000 units, including shipping charges, was to cost $50,000,000 chargeable to lend-lease requirements.

Houses were criticized

Designed by the FPHA, the houses for Great Britain have been criticized by some prefabricators in this country as a poor demonstration of American practice. It is reported that the houses would be classified as sub-standard in this country and that the market for them here would be negligible.

One of the fabricating contractors, interviewed recently by an *ENR* editor, said, "This house probably incorporates everything that a 'prefab' shouldn't have. It is wasteful of material, contains far too many parts and can be erected only with skilled help."

This contractor, who has had many years experience in house prefabrication, pointed out that the design called for the assembly of 32 different size wall panels some of which varied in width by only ene-eighth inch.

"Since this house is 24 by 24 ft. in plan," he continued, "it would have been perfectly simple to adopt a 4 ft. modular design and on this basis you wouldn't need more than three different types of panels to fit all conditions."

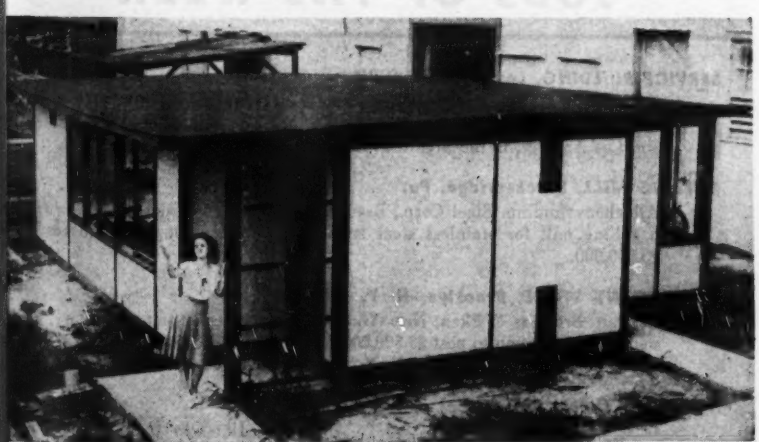
Stand of FPHA

In reply to criticism published in the April issue of *Prefabricated Homes*, a spokesman for the FPHA said:

"Our experience with prefabrication during the war period has given us an extensive familiarity with the techniques involved. The application of prefabrication techniques, however, depends in each case on various factors. In this case, determining factors were the requirements made by the British out of consideration of climate, building practices and national preferences prevailing where the houses are to be used. It is for this reason that the result differs somewhat from units designed for use in this country.

"Our responsibility is to produce a house that conforms to the specifications laid down for us by the British, and to do so in ways that make minimum use of critical materials and meet requirements for packaging and shipping. That we were able to achieve a fair degree at efficiency and economy is demonstrated not only by the large number of bids—a total of 146—but also by the fact that we were able to obtain an average construction price of $1,310 per unit."

The editors of *Prefabricated Homes* stated that the FPHA house called for a much greater variety of wall panels than required on most American systems, preventing most economical and speedy mass production. It was predicted that through offering this type of house to the British public, prefabrication would become synonymous with temporary construction, and such houses will be harmful to the prestige of the prefabricated home industry.



Wide World photo

Termination of lend-lease aid was the reason given by the British government last week for the cancellation of some 17,000 units of prefabricated house pictured above. Designed to provide temporary shelter for bombed-out families in Great Britain, the wood and fiberboard panel house contains two bedrooms, a living room, kitchen and bath. The Harrison Construction Co. of Miami, Fla., at whose plant the above photo was taken, is one of some 45 contractors affected by the cancellation order.

Senate approves $375,000,000 fund as federal aid for airport building

Authorizes expenditure of $75,000,000 for five years if matched on 50-50 basis by local sponsors—Money distributed by states

Expenditure of $375,000,000 of federal aid for a 5-yr. airport program is provided in a bill (S. 2) passed by the Senate Sept. 12.

This amount is only three-fourths the aid the Senate was expected to approve, (*ENR* Sept. 13, p. 335) but when matched by local funds on a 50-50 basis the money would result in a total airport construction program costing $750,000,000.

The Senate approved $75,000,000 of federal aid annually for 5 years, provided this help is matched on a 50-50 basis by state and local groups. The first year's money would become available at the start of the first fiscal year after the war emergency has been declared ended by Congress or the President. However, the bill would make $3,000,000 available immediately through the Civil Aeronautics Administration for planning and making surveys.

The House has passed no airport bill as yet, but the House Committee on Interstate and Foreign Commerce has recommended passage of a bill (H. R. 3615) providing $700,000,000 of federal funds over a 10-yr. period (*ENR* July 12, p. 21). Since the bill approved by the Senate appropriates about the same amount of aid yearly as the measure before the House, no difficulty is anticipated in passing a compromise bill providing at least as much money as the Senate authorized.

Small airfields get preference

As finally passed, the Senate bill requires that at least 65 percent of the appropriation for a given year be used for construction of smaller airfields or those in Classes 1, 2 and 3 as defined by the CAA. This part of the aid would be apportioned by the CAA administrator to the several state airport agencies. The apportionment would be based one-half on the proportion the population of a given state bears to the total population of the country, and one-half on the basis of the area of a state to the U. S. total.

The remaining 35 percent would be available for distribution through state airport agencies for the construction of large airfields or those designated Class 4 and 5 by the CAA. However, in case there was no demand in a given state for all of the money earmarked for large fields, a state could obtain approval to use such aid for constructing smaller fields.

Allowable project costs, as defined by the Senate bill, includes expenditures to acquire the necessary site. If this feature is included in the bill finally made law, it could result in great benefit to larger municipalities attempting to acquire sites for landing fields nearer the center of their communities.

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Bill proposes check on Federal agency finance

The House of Representatives has passed a bill providing for financial supervision By Congress of a list of some 41 federal corporations with assets of $29.6 billion, liabilities of $28.4 billion and a net worth of $1.2 billion.

The bill requires each corporation to submit annual budgets to Congress and to submit their operations to annual commercial-type audits. Corporations involved include: Institute of Inter-American Affairs, Export-Import Bank, and the Defense Plant Corporation. The measure exempts the Tennessee Valley Authority.

Bid for Merriman Dam rejected as too high

The New York City Board of Water Supply rejected all bids for completion of Merriman Dam, key structure of the Delaware Aqueduct, as unit prices offered were 70 percent more than bids on the same work taken in 1939.

S. A. Healy Co. of Chicago were low bidders on Sept. 11 for completion of the rolled-fill structure 85 miles northeast of New York City. Low bid was $13,919,950; Del Balso Constr. Corp. and Rusciano & Sons bid $14,602,000; and other bids ranged up to $19,121,000.

In 1939 Mason & Hanger contracted to build the dam, a 600 ft. shaft, 1¾ miles of tunnel and appurtenant works for $15,486,000. Work was suspended in 1942 and the contract settled for $7,425,000. The work bid on recently was substantially the same that would have been completed for little more than $8,000,000 if the job could have gone on as planned. Increased labor cost is given as the principal reason for the higher bid prices. A tabulation of unit prices and an analysis of the project appearing in an early issue.

The Board of Water Supply expect to work out some plan whereby the contractor's contingency on the four year contract will be reduced. Roger W Armstrong, chief engineer, stated that there is no thought of doing the work with forces of the Board of Water Supply and that the job soon will be readvertised.

JOBS OF THE WEEK

SERVICE BUILDING, Los Angeles, Calif.

Baruch Corp., Los Angeles, Calif., has been awarded a contract for a 6-story, service building by The May Co., Los Angeles, to cost $1,500,000. A. G. Martin, Los Angeles, is the architect.

ROLLING MILL, Brackenridge, Pa.

Allegheny Ludlum Steel Corp., Brackenridge, will construct, by its own forces, a rolling mill for stainless steel strip, reerecting existing mill, to cost about $3,000,000.

DEPARTMENT STORE, Brooklyn, N. Y.

Starrett Brothers & Eken, New York, N. Y., will construct an 8-story, department store addition to cost $3,500,000 for Abraham & Straus, Brooklyn. Shreve, Lamb & Harmon, New York, N. Y., are the architects.

HOSPITAL, Hines, Ill.

Gust K. Newberg Construction Co., Chicago, Ill., was the lowest bidder at $4,493,763 for a hospital, when the Veterans Administration, Washington, D. C., opened bids.

GAS PIPE LINE, Texas and Louisiana

O. C. Whittaker Co., Houston, has been awarded a contract for a 143-mile 24-in. natural gas pipe line from Carthage, Tex., to Monroe, La., by United Gas Pipe Line Co., Shreveport, La. The estimated cost is $7,150,000.

Note—Additional bidding and contract news on many projects large and small, including the above items, appear in the Construction News section beginning on page 203.

OBITUARY

Anthony F. Maischaider, 62, who had just retired as assistant engineer for the New York Central Railroad, died at Cincinnati, Ohio, recently. He had been employed by the railroad since he was graduated from Purdue University in 1902.

Capt. Sidney R. Greer, 30, former Texas Highway Department junior resident engineer at Dallas, and brother of Dewitt C. Greer, State Highway Engineer, died as a prisoner of war in Japan in February according to word received from the War Department. He was captured in 1942 by the Japanese in the Philippines where he was engineer in charge of the Del Monte Airfield on Mindanao. He was graduated in civil engineering from Texas A. and M. College in 1935.

Ben L. Allen, 74, died at his home in Garden City, Kan., recently. He had been county engineer of Finney County since 1920, and was a past president of the Kansas Counties Engineers' Association.

John O'Gara, 78, founder and president of the Marquette Construction Co., Chicago, died Sept. 6 in that city. Mr. O'Gara's company, founded in 1907, and dissolved six months ago, pioneered in subway construction and concrete paving.

Frank A. Kessing, 81, retired structural engineer, died Sept. 6 at Indianapolis, Ind.

William Clemson Sharples, 70, an engineer with the Smaller War Plants Corp. in Philadelphia, Pa., died Sept. 5.

Paul LeGavrian, Secretary General of the Permanent Association of International Road Congresses, Paris, died at Versailles, France, recently. He attended the World Congress in Washington in 1930, and organized road congresses in the United States and other countries.

John P. Neale, 57, Lake Forest, Ohio, chief engineer for the Lake Forest city water works for 25 years, died Aug. 25.

Albert Irving Reed, 82, died Sept. 2, in Milwaukee, Wis. He was graduated as a civil engineer from the University of Minnesota in 1885. Mr. Reed was employed on location and construction work for various railroads including the Mexican Central and the Great Northern until 1895, when he joined the U. S. Corps of Engineers, and was assigned to harbor improvement in Racine, Sheboygan and Milwaukee.

Maj. William A. Richardson, 55, British Columbia engineer, a graduate of the University of Toronto and veteran of two world wars, died in New York Aug. 29. Major Richardson, who won the Military Cross for gallantry in action in France in the first war, signed up at the start of Wold War II, and went to Petawawa, where he commanded the survey wing of the Royal Canadian Air Force for three years.

James H. LaVell, superintendent of the paving department, bureau of streets, Chicago, Ill., for 40 years prior to his retirement a year ago, died Aug. 28 in Florida.

John M. Irvine, 50, civil engineer and head of John M. Irvine Associates, Philadelphia, Pa., died Sept. 4. He was a graduate of New York University and Massachusetts Institute of Technology. He served overseas with the Army Engineers in the First World War and formerly was assistant to the president of the engineering firm of Albright and Friel.

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Vote road, hospital bonds

Taxpayers of Dallas County, Tex., recently voted bond issues totalling $9,000,000 for acquisition of rights-of-way for new highways; and construction of a 9-story city-county hospital, tuberculosis hospital, nurses' home and other facilities.

The $2,000,000 right-of-way bonds will finance acquisitions for a 32-project road program already designated in part by the State Highway Department.

A drive to obtain $9,525,000 for construction of four new hospitals in Greater Cleveland, O. and expansion of thirteen other hospitals will get under way soon.

Robert F. Bingham, chairman of the joint hospital planning committee of the Cleveland Welfare Federation and the Cleveland Hospital Council said that four new hospitals are planned, two of which will provide 200 beds and cost a total of about $2½ million, another an interracial hospital, to cost about $600,000, and a fourth, costing $600,000, for approximately 100 patients. Existing hospitals will also be expanded with funds obtained from the drive.

Meetings freed by new ODT order

Editor's note: Removal last week of all government restrictions on travel, conventions and meetings has now made it possible for the many associations of engineers and contractors to resume their national, regional and sectional sessions.

With this issue, therefore *ENR* resumes listing these meetings as a regular feature of its service to readers.

TEXAS WATER CONSERVATION ASSOCIATION, yearly meeting, Austin, Tex., Oct. 3-4.

AMER. WATER WORKS ASSOCIATION:

(Tentative) FOUR STATES SECTION, Philadelphia Area meeting at inn near Norristown, Pa., Oct. 5.
SOUTHWEST SECTION, Washington-Youree Hotel, Shreveport, La., Oct. 16-17.
CALIFORNIA SECTION, Biltmore Hotel, Los Angeles, Calif., Oct. 23.
OHIO SECTION, regional meeting of North West Section, Y.M.C.A., Findlay, Ohio, Oct. 23.
ILLINOIS SECTION, La Salle Hotel, Chicago, Ill., Oct. 30-31.
NORTH CAROLINA SECTION, Hotel Charlotte, Charlotte, N. C., Nov. 5-7.
VIRGINIA SECTION, Hotel Roanoke, Roanoke, Va., Nov. 8-9.
NEW JERSEY SECTION, Hotel Madison, Atlantic City, N. J., Nov. 9.
WISCONSIN SECTION, Pfister Hotel, Milwaukee, Wis., Nov. 13-15.
FLORIDA SECTION, Gainesville, Fla., Nov. 15-17.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, 6th annual water conference, William Penn Hotel, Pittsburgh, Pa., Oct. 22-23, in conjunction with the Civil Section.

AMERICAN PUBLIC WORKS ASSN., Fifty-first annual congress, Sherman Hotel, Chicago, Ill., Nov. 4, 5 and 6.

NORTH DAKOTA WATER AND SEWAGE WORKS CONFERENCE, Annual conference, Gardner Hotel, Fargo, Nov. 8 and 9.

OHIO CONFERENCE ON SEWAGE TREATMENT, Fort Hayes Hotel, Columbus, Oct. 31 and Nov. 1.

Traffic over the Lower Santee River Bridge, between Charleston and Georgetown, S. C., has been resumed. The bridge has been closed since July, when 1,200 ft. of the 2-mile span was damaged by fire.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Estimating Floods by Statistics

Sir: There are a number of concepts relative to flood frequency that were discussed by E. J. Gumbel (*ENR* June 14, 1945) that could be approached differently and, I believe, from sounder premises. For example, the daily flows at any one station could not be considered as a frequency distribution because the data are not independent: the flow of one day is closely related to that of the preceding day. However, distinct flood peaks nearly always result from causes sufficiently different that the data are really independent.

Although advocated by many persons besides Mr. Gumbel, the method of basing flood frequencies on the maximum annual flood does not appear to be the best procedure. Other floods, which may be nearly as large and may be even more damaging, are ignored. Since damaging floods do not come with any regularity, the distribution made by selecting the maximum annual flood is distorted and does not represent the true conditions. A sounder procedure is to use all data of floods above a carefully selected base rate of flow.

The computation of flood frequency is in reality a double problem, namely, the determination of the probability of the magnitude and the probability of time, or occurrence. The probability of magnitude can be obtained by using a function with a logarithmic transformation of the variable such as the "partly bound" function proposed by Prof. Slade (*Transactions*, American Society of Civil Engineers). The frequency can then be found by combining the probability of magnitude with the average number of floods per year.

The plotting of a reasonably good series of data of floods above a selected base flow will produce a straight line on the Hazen paper, which uses the logarithmic versus probability coordinate scales, unless the floods result from two or more distinct causes. This paper provides the best quick graphical method of obtaining flood frequencies. The plotting position of the maximum flood can and should be neglected, since it is so much the result of chance that its frequency cannot be estimated by plotting a single observation. The curve will be determined by the main body of the data.

A serious objection exists against the use of such a formula as $(M - 1)/N$ or $(M - 0.5)/N$ to determine the frequency of floods. Such a formula would assign to the maximum flood in any period of observation the same frequency regardless of its magnitude. This is plainly contrary to experience and theory, since both agree that the greater the flood the smaller the probability of occurrence, or the greater its "return period." Rather than depend upon empirical formulas of doubtful validity, the writer believes that the problem of flood frequency can best be solved by frank and full acceptance of the theory of statistics.

EDGAR E. FOSTER
Hydraulic Engineer
Stanley Engineering Co.

Bracing in Towers

Sir: There is a feature in the design of light steel towers, such as radio towers, that I think designers have overlooked. It concerns the ratio of slenderness of the four corner posts.

In traveling about, I have at times observed in these towers a condition as indicated in the sketch.

At BB to GG no horizontal diagonal braces are used (as at AA and HH). The designer's idea appears to be that if the corner posts are braced at A and H, the posts will thereby be held against movement at B to G by reason of the diagonal braces in the sides of the tower. These diagonal braces, however, do not prevent the rectangles at the intermediate levels B to G from assuming the shape shown to the left in the sketch, thus bending the posts in the weak direction, which means a large slenderness ratio in the corner posts.

Assuming the length AH to be 35 ft. and the corner angle to be 4 x 4 x $\frac{3}{8}$, the ratio of slenderness is 546, and the ultimate load, by the Euler formula, is 966 psi. or a total *ultimate* load on the post of 2,760 lb., which is quite small.

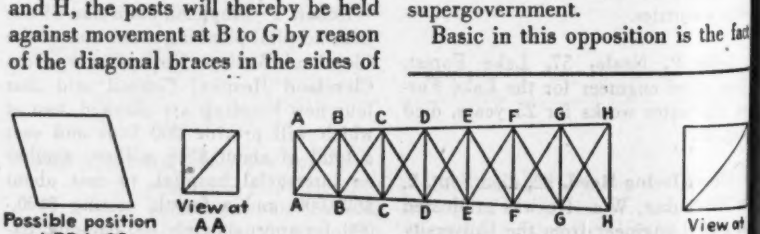
Of course the posts are not pin-ended at A and H, but neither are they fixed-ended, so that the vertical free length is somewhat less than 35 ft. The introduction of a few stiff horizontal braces, as at AA and HH, would add enormously to the actual strength of towers of this sort.

EDWARD GODFREY
Pittsburgh, Pa.

River Valley Authorities

Sir: The letter of James S. Sweet (*ENR* May 17, vol. p. 692) is highly provocative to Western minds, both lay and engineering, because it is so typical of the general lack of understanding of Western conditions and their urgent bearing on the matter of proposed river authorities. Mr. Sweet may rest assured that at the proper time the opposition of the irrigated West will be consequential enough. He may then be surprised to find that associated with the 17 arid Western states are his own state (New York) and many others in New England and the Northeast. It will then be apparent also that Western opposition springs from the soil and that quite independent of their state authorities and of the Corps of Engineers or the Bureau of Reclamation, the people of the arid West have a personal stake in their neighborhood and its development, that they do not care to risk in the hands of supergovernment.

Basic in this opposition is the fact



Improper bracing in towers permits distortion in the horizontal plane.

that west of the 97th meridian, irrigation is a necessity if food is to be produced in quantities even remotely approaching the local requirement. Contrary to the general assumption that irrigation is a fad or an attempted refinement on the traditional methods of farming, it cannot be too strongly insisted that in the West there are only three alternatives—irrigate, import food or starve. It needs only to add that such agricultural products as the irrigated West is able to furnish beyond its own needs, and it is by no means independent of the rest of the country in supplying those needs, consist almost entirely of food products not competitive with those of other farming areas in the United States.

Water rights are paramount

Within the compass of this letter it will not be attempted to set out the developments that directed and have attented the pioneering of irrigation. It must suffice here to say that the Congress of the United States by its Acts of 1866, 1870 and 1877 indicated clearly to the people of the West how they should set about the use of water for their obvious necessities and affirmed their right so to do, which affirmation has repeatedly been upheld by the Supreme Court of the United States.

The direction of the Congress was very plain. Due to the peculiar local conditions settlers were to appropriate or take water for their peculiar uses, and would thereby acquire a right for those uses by the taking which had all the elements of property. The Congress also directed, at least by implication, that this being a matter of purely local concern, the people, by their local governments, were to regulate themselves in the exercise of what the Congress recognized as at once a necessity and a right.

Over a period of 80 years there has grown up in the states where irrigation is practised, a body of tens of thousands of individual rights to the use of water.

True, as between these individual rights the several states are, under law, given administrative powers, but it cannot be too strongly emphasized that these are individual rights of great value—the land these rights irrigate is worthless without them. This being so, the owners of these rights, many of whom built their irrigation works with their own hands, cannot tolerate a situation in which any body of men, with power greater than that now exercised by the United States, may assume to say that in their judgement these individual rights or any of them, must be abrogated to serve the schemes of an authority which may, or may not, in actuality, be proposing something of greater value to the community. These rights, most of them of a very respectable age, have a value for which their owners cannot be compensated by the payment of money as against the necessity to abandon their long accustomed habitat and way of life. Nor is it by any means certain that the judgment of any such body of men will prove superior to the consensus of all the individual judgments which have operated against economic necessity over long periods, to bring this system of water use to its present development. There are few cases of record where the piecemeal development of the West has worked any considerable injury to any neighborhood or large number of people. In these later years of drouth and more complicated developmental necessities, it has not been found too great an undertaking to apply the correctives that the process of such individual development may have entailed.

Supergovernment opposed

Finally, if the people of the West understand the essentials of our government, as they believe they do, it is still one of laws, not of men. Their rights, without which they are penniless, are founded in law, and they desire that those rights shall remain so founded. If, as may occasionally be true, this results in development not so pretty, nor even so efficient as might be carried out by supergovernment, this is the price that must be paid in the United States for the form of government it has heretofore had. Western people do not think that price too high for their liberty of action, of which they want more, not less.

Both the Corps of Engineers and the Bureau of Reclamation have had many years experience in the building and operating of just the sort of projects necessary to develope Western rivers, each in its own sphere. Instances of record do indicate that without any changes in their basic organizations, these and other interested agencies can cooperate, when it is necessary or desirable. It is not an undesirable feature of the situation, in the minds of Western people, that these several agencies shall be brought to collaborate and cooperate by the wishes of those who, in the case of irrigation works, will be required to make maximum repayment within their ability, of the cost of such works, or who, for flood control or related works, will be expected to contribute according to requirements set up by the Corps of Engineers. It may be fairly assumed, that if local people are willing so to reimburse the United States they are getting something that will be of use to them and to the nation.

Whatever may be the final justification of TVA, the people of the irrigated West are by no means convinced that at the present moment it can be said to have made its case. They are, moreover, quite sure that in view of their peculiar and permanently necessary local requirements, there is no place for the authority idea on the rivers of the arid West.

Quite aside from this discussion of river authorities as a purely local matter, it is desired to add a small tribute to the electrical industry as a whole. No attempt is here made to justify the financial practices that have so strongly colored all public thinking about the industry during recent years. It is desired, however, to point out that upon the technical and operating side the electrical industry has a record over the last 50 years, of the greatest achievement and of the closest cooperation between science, manufacture and operation, for the benefit of the ultimate consumer, that the world has ever seen. Newcomers in the field who assume that with their novel ideas they can excel that record have undertaken a chore for which they may yet prove inadequate. The fact that these newcomers demand a closed field and unlimited authority over the resources and people of great regions, shows that they are not willing to submit to that necessity which was the spur to that industry in the past.

F. C. MERRIELL
Secretary,
The Colorado River Water Conservation District, Grand Junction, Colo.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Estimating Floods by Statistics

Sir: There are a number of concepts relative to flood frequency that were discussed by E. J. Gumbel (*ENR* June 14, 1945) that could be approached differently and, I believe, from sounder premises. For example, the daily flows at any one station could not be considered as a frequency distribution because the data are not independent: the flow of one day is closely related to that of the preceding day. However, distinct flood peaks nearly always result from causes sufficiently different that the data are really independent.

Although advocated by many persons besides Mr. Gumbel, the method of basing flood frequencies on the maximum annual flood does not appear to be the best procedure. Other floods, which may be nearly as large and may be even more damaging, are ignored. Since damaging floods do not come with any regularity, the distribution made by selecting the maximum annual flood is distorted and does not represent the true conditions. A sounder procedure is to use all data of floods above a carefully selected base rate of flow.

The computation of flood frequency is in reality a double problem, namely, the determination of the probability of the magnitude and the probability of time, or occurrence. The probability of magnitude can be obtained by using a function with a logarithmic transformation of the variable such as the "partly bound" function proposed by Prof. Slade (*Transactions*, American Society of Civil Engineers). The frequency can then be found by combining the probability of magnitude with the average number of floods per year.

The plotting of a reasonably good series of data of floods above a selected base flow will produce a straight line on the Hazen paper, which uses the logarithmic versus probability coordinate scales, unless the floods result from two or more distinct causes. This paper provides the best quick graphical method of obtaining flood frequencies. The plotting position of the maximum flood can and should be neglected, since it is so much the result of chance that its frequency cannot be estimated by plotting a single observation. The curve will be determined by the main body of the data.

A serious objection exists against the use of such a formula as $(M - 1)/N$ or $(M - 0.5)/N$ to determine the frequency of floods. Such a formula would assign to the maximum flood in any period of observation the same frequency regardless of its magnitude. This is plainly contrary to experience and theory, since both agree that the greater the flood the smaller the probability of occurrence, or the greater its "return period." Rather than depend upon empirical formulas of doubtful validity, the writer believes that the problem of flood frequency can best be solved by frank and full accep-

the tower. These diagonal braces, however, do not prevent the rectangles at the intermediate levels B to G from assuming the shape shown to the left in the sketch, thus bending the posts in the weak direction, which means a large slenderness ratio in the corner posts.

Assuming the length AH to be 35 ft. and the corner angle to be 4 x 4 x $\frac{3}{8}$, the ratio of slenderness is 546, and the ultimate load, by the Euler formula, is 966 psi. or a total *ultimate* load on the post of 2,760 lb., which is quite small.

Of course the posts are not pin-ended at A and H, but neither are they fixed-ended, so that the vertical free length is somewhat less than 35 ft. The introduction of a few stiff horizontal braces, as at AA and HH, would add enormously to the actual strength of towers of this sort.

EDWARD GODFREY
Pittsburgh, Pa.

River Valley Authorities

Sir: The letter of James S. Sweet (*ENR* May 17, vol. p. 692) is highly provocative to Western minds, both lay and engineering, because it is so typical of the general lack of understanding of Western conditions and

TIGH
BOU

that west of the 97th meridian, irrigation is a necessity if food is to be produced in quantities even remotely approaching the local requirement. Contrary to the general assumption that irrigation is a fad or an attempted refinement on the traditional methods of farming, it cannot be too strongly insisted that in the West there are only three alternatives—irrigate, import food or starve. It needs only to add that such agricultural products as the irrigated West is able to furnish beyond its own needs, and it is by no means independent of the rest of the country in supplying those needs, consist almost entirely of food products not competitive with those of other farming areas in the United States.

Water rights are paramount

Within the compass of this letter it will not be attempted to set out the developments that directed and have attented the pioneering of irrigation. It must suffice here to say that the Congress of the United States by its Acts of 1866, 1870 and 1877 indicated clearly to the people of the West how they should set about the use of water for their obvious necessities and affirmed their right so to do, which affirmation has repeatedly been upheld by the Supreme Court of the these rights, many of whom built their irrigation works with their own hands, cannot tolerate a situation in which any body of men, with power greater than that now exercised by the United States, may assume to say that in their judgement these individual rights or any of them, must be abrogated to serve the schemes of an authority which may, or may not, in actuality, be proposing something of greater value to the community. These rights, most of them of a very respectable age, have a value for which their owners cannot be compensated by the payment of money as against the necessity to abandon their long accustomed habitat and way of life. Nor is it by any means certain that the judgment of any such body of men will prove superior to the consensus of all the individual judgments which have operated against economic necessity over long periods, to bring this system of water use to its present development. There are few cases of record where the piecemeal development of the West has worked any considerable injury to any neighborhood or large number of people. In these later years of drouth and more complicated developmental necessities, it has not been found too great an undertaking to apply the correctives that the process

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F. C. MERRIELL
Secretary,
The Colorado River Water Conservation District, Grand Junction, Colo.

EDITORIALS

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Engineers for Civil Works

THE GREAT GAP construction is expected to fill in maintaining full employment requires the full time services of all available civil engineers at the earliest possible moment that they can be released from war assignments. Many plans must still be prepared and staffs must be recruited to handle major construction operations in the field if we are even to approach the great increase in construction volume that has been glibly promised for the industry. Many engineers will continue to be essential in the armed services to build or revise the facilities for occupation and for returning troops. On the other hand, every effort should be made to expedite the release of engineers on less essential military work so that they may be employed on the preparation of plans for projects that will provide work for others. These men, who have done an outstanding job in planning and building for war, can help immeasurably now in expediting the return to full peacetime construction.

Prefabricated House Fiasco

TERMINATION of lend-lease aid is the reason given for the cancellation by the British of 17,000 units of a 27,000 order for prefabricated houses. While this is a valid reason, there are some prefabricators in this country who interpret the cancellation as confirmation of their early predictions that these "prefabs" would be unsuitable to the British and damaging to the prestige of America's prefabricated house industry. As detailed on page 89 of this issue, the house was designed by the Federal Public Housing Authority, contracts for fabrication being awarded to some 45 firms. The design was such as to call for a great variety of panels, some of which differed in size by only one-eighth inch, and this led at least one contractor to characterize the house as an inept and crude demonstration of assembly that violated fundamental principles of prefabrication technique. This same contractor charged that the FPHA was not sympathetic toward making changes that would have simplified assembly and might also have resulted in substantial manufacturing economies. While the British action does not in itself validate these criticisms, it would seem to indicate that the British do not think the houses are worth real cash money. With all the prefabrication talent that seems to be available both in and out of government service, it is difficult to understand why more of it was not used more effectively by the FPHA.

Revetments by Contract

AN IMPORTANT ASPECT of the new type of revetment for levees along the lower Mississippi River that is described in this issue is not immediately apparent in that account. It is the fact that this new type calls for so little special equipment as to make it practicable for the Army Engineers to let the fabrication and laying of this revetment to contract. Heretofore, the articulated concrete mat widely used along much of the lower river, and the asphalt mat used to a lesser degree in the New Orleans district, required such elaborate special equipment as to make it necessary for the Army Engineers to do the work with hired labor. Also, that condition strictly limited the number of operations that could be undertaken simultaneously. With the new type requiring no equipment that cannot be obtained easily by a general contractor, bids can be called on several jobs at one time, thus speeding the rate at which protection can be provided, while at the same time giving the Army Engineers the benefit of contract operations. In addition, the new type requires much less concrete than the old articulated concrete mat and can be laid more quickly and with less chance of mishap. Taken as a whole, the new mat marks a long step forward in the Army Engineers fight to keep the river within its banks.

Federal Money for Local Works

THOSE WHO HAVE BEEN HOPING for—as well as those who have been demanding—federal grants for the construction of local government works, must have garnered hope from President Truman's message to Congress (*ENR* Sept. 13, vol. p. 335) recommending federal assistance for state and municipal public works even though he is endorsing a principle regarding which there is a wide divergence of opinion. A large body of thought is to the effect that the $260 billion federal debt should not be increased at a time when state and local governments bear the relatively light load of $17 billion indebtedness. Yet there is a vocal group of municipal administrators who make light of this situation and picture their city's distress as one to be alleviated only with the balm of federal grants. Perhaps

the best qualified recent appraisal of the role of federal financing is that made by the House Special Committee on Postwar Economic Policy and Planning (*ENR* July 5, vol. p. 2). Here it is stated that the ability of state and local governments to finance new construction will apparently outrun for a time the facilities available to undertake the work. And the committee sees no need, in the early years of peace, to stimulate local public works at a time when such construction would be pitted against private construction in securing materials and equipment. Recognizing that over a long-term period there may be need to cope with unemployment, the committee subscribes to federal aid—not in the form of grants, however, but through advances that eventually would be repaid by the borrower. Herein, we believe, is the basis of a policy that will best serve the economic welfare of the nation and the construction industry.

The Chief of Engineers

MOST INFLUENTIAL, single position in American civil engineering and construction is that of Chief of Engineers, U. S. Army, because, war or peace, year after year he utilizes enough of the facilities of the construction industry to affect profoundly both its techniques and its business practices. It is of more than ordinary interest, therefore, when the mantle of the office is shifted to new shoulders, as it will be next week when Lt. Gen. Raymond A. Wheeler replaces Lt. Gen. Eugene Reybold, who has headed the Corps of Engineers during the most active and productive four-year period in its 170-year history.

General Reybold took over this office at a time when expanding defense construction made it desirable for the Corps of Engineers to absorb the construction division of the Quartermaster Corps. After war was declared there was placed on him responsibility for a program of camp and military base construction that dwarfed all previous construction operations in both magnitude and diversity. He handled that difficult task with a skill and understanding that won him wide admiration.

A Chief of Engineers has need of a multitude of talents; as for example, technical and administrative ability, broad military sense, intimate acquaintance with the construction industry, including its personnel, problems and possibilities, a national as contrasted with a military-organization viewpoint, and professional and political honesty. Always important, the need for such talents is enhanced now when flood control and river and harbor work seem destined to dwarf their previous stature, and when our national safety more than ever before depends upon military engineering preparedness. Moreover, the future will require that the man who heads the Army Engineers have first-hand knowledge of foreign countries and of international affairs generally, something not previously given particular weight.

It is gratifying to record, first, that a half-dozen or more Engineer officers capable of meeting these specifications emerged from the crucible of war, and second, that none could have been selected with better prospects of meeting the challenges of the times ahead than General Wheeler. Entrusted before Pearl Harbor, and therefore in great secrecy, with the first important military task abroad—establishing the basis for support of the British in Egypt and North Africa and for supply of the Russians across Persia—General Wheeler achieved speedy results, and went on to head the Services of Supply in the China-India-Burma theatre and eventually to be top U. S. commander there. He thus brings to the Office of the Chief of Engineers not only the required competence in foreign military engineering affairs, but also a proved ability to carry heavy responsibilities and to administer a large and important organization.

General Wheeler's prewar experience in all phases of national flood control, in maintenance and construction of the Panama Canal and in commanding a regiment of Engineers in the First World War has provided him with other of the necessary talents. That he will have need of all of them is evident from some of the problems that will await his attention. Most important is compressing the greatly expanded Engineer war machine into an organization that will lead the world in military engineering research and training, while of only slightly less priority are such other detailed problems as river basin development, disposal of surplus equipment and construction at overseas bases to name a few. All in all the greatest responsibility, and likewise opportunity, that has ever reposed in the Office of the Chief of Engineers awaits General Wheeler. And fortunately for the construction industry, as well as for the nation, both his peacetime experience and his brilliant war achievements argue strongly for his success.

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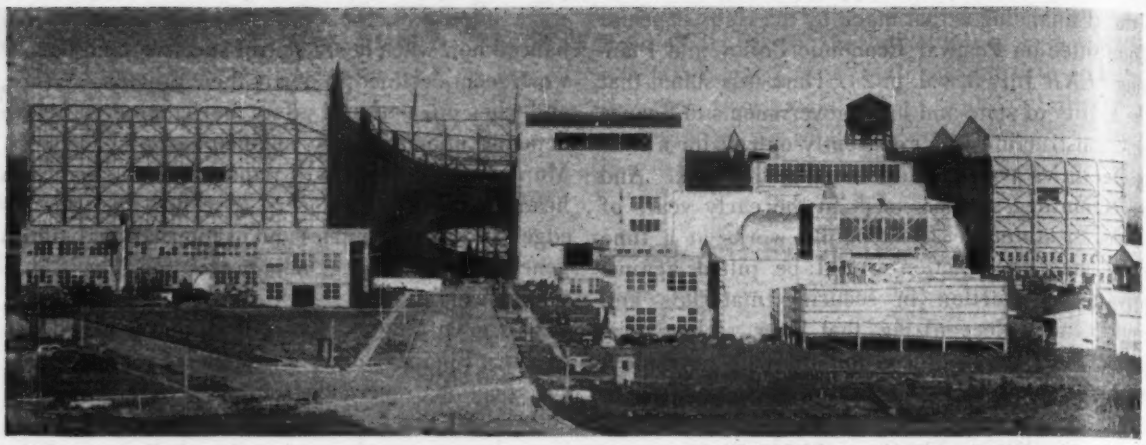


National Advisory Committee for Aeronautics, photos

Fig. 1. Plant and equipment required to test full-size planes in the steel throat of wind tunnels at Moffett Field, Calif.

Erecting Steel for Tornado in a Tunnel

Gordon R. Lunt
Project Manager,
Pittsburgh-Des Moines Steel Co.

***Editor's Note**—Building the world's largest wind tunnel at Moffett Field, Calif., was an exacting job of steel erection, requiring unusual planning of the work and scheduling of the material. Special traveling stiffleg derricks mounted on high towers were designed for the setting of the steel. Close tolerances in the framing test section and setting the supports for six 40-ft. fans necessitated maintaining a careful check of all operations.*

A TORNADO IN A TUNNEL literally describes the huge Ames Aeronautical Research Laboratory at Moffett Field, Calif., where full-size airplanes can be tested in a man-made gale greater than any wind nature has to offer. Built for the National Advisory Committee for Aeronautics, the laboratory is the world's largest wind tunnel, towering 173 ft. high, looping around an 8-acre area 400x868 ft. in outside dimensions. The tunnel itself varies in cross section from the 40x 80-ft. oval shaped test section to a 133x173-ft. rectangle in the return section. Six 6-bladed propeller-type fans, which completely fill the cross section at one point, generate the wind in the closed loop. The magnitude of the project is probably most strikingly indicated by the fact that each fan, with propeller blades 40 ft. in diameter, is driven by a 6,000-hp. electric motor.

While some details of design and operation of the laboratory still remain a military secret, the construction story can now be told.

The wind tunnel, essentially a closed continuous passage through which air is circulated by the fans, consists of two main parts—the test section and the return section. Occupying most of the long east side, the test section consists of a steel throat of butt-welded plates held by longitudinal ribs, which in turn, are bound by outside truss ring girts. Starting as a rectangle 132½ ft. wide and 172½ ft. high, the entrance cone of the throat tapers down to an oval 80 ft. wide and 40 ft. high at the entrance to the test section. To compensate for skin friction, the test section itself flares out slightly 3½ in. in width and height to the beginning of the exit cone. The exit cone transforms to a rectangle 68 ft. 7 in. x 108 ft. 7 in. to complete the steel throat.

The remainder of the tunnel loop, consisting of the north and south ends and the long west side, is considered as the return section. In the west leg is the fan assembly, made up of six separate tubes, 40 ft. in diameter and 140 ft. long, arranged in two horizontal rows of three fan units each. These tubes, each containing a six-bladed propeller type fan 40 ft. in diameter at the motor section, driven by a 6,000-hp. electric motor, are faired into the return passage fore and aft. The fan assembly housing, 140 ft. long, is built up of steel plates, structural steel and reinforced concrete. Fans and motors are mounted on structural frames. Air speeds in excess of 200 m.p.h. can be created by the fans.

All the rest of the return section is a steel frame structure of mill type construction, with corrugated cement asbestos siding and asbestos-protected metal ceiling and flooring. Wall framing of this structure consists of outside vertical trusses supporting steel girts to which the sheeting is fastened. The return passage includes four 90-deg. turns, in each of which are a set of curved vertical guide vanes (4,488 vanes in all) extending from floor to ceiling. These

anes, which efficiently turn the fast-oving air around the corners, are combination of wood and sheet etal.

The steel test section is surrounded y a separate building of mill type onstruction, 125 ft. long, 180 ft. ide and 161½ ft. high, sheeted top nd sides with cement asbestos. A air of huge hinged doors, hydrauli-lly operated, form the top of the st section proper to allow placing f full-sized airplanes and other large erodynamic models. These doors ck-knife into open position to pro-ide a clear opening the full 80-ft. idth of the chamber and 50 ft. long. here is an access door and a walk-ay for entrance into the chamber.

An elaborate aircraft support sys-m located in the test chamber, but n independent foundations, permits ounting the test plane in different ositions. This support arrangement ansmits loads (test data) to a bal-nce system located in a room be-w. The model under test can also e observed from the outside through lastic glass panels in the chamber alls. Hoisting equipment to serve e test chamber includes 3-ton and 0-ton hoists operating on a travel-g bridge, a 5-ton gantry crane and n electric elevator.

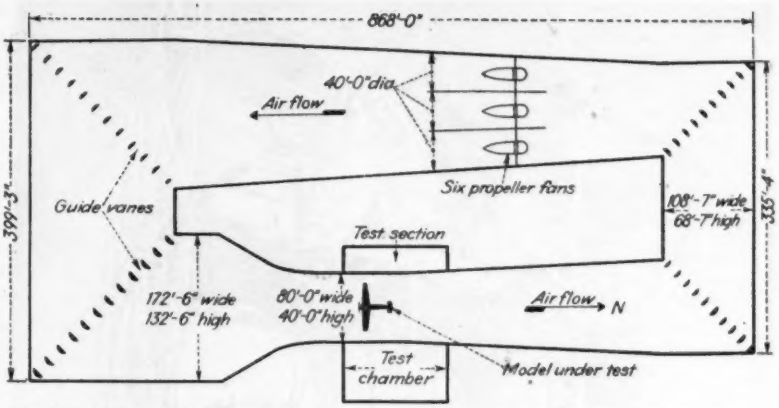


Fig. 2. Diagrammatic layout of the big wind tunnel used in testing full-size planes. Guide vanes, extending from floor to ceiling, number 4,488.

The entire wind tunnel structure is carried by concrete piles through heavy reinforced concrete footings.

Offices, storage rooms, boiler rooms and electrical equipment rooms are provided in the space between grade and the floor of the return passage at the north end of the structure. A 200,000-gal. elevated water storage tank was erected in the area enclosed by the tunnel.

More than 12,000 tons of fabricated structural steel and plates went into the structure for which nearly 2,000 sheets of detailed drawings were made. While some heavy members were required at the motor supports and test section, most of the pieces were quite light. As there was very little duplication, keeping track of the vast number of different pieces during fabrication, yarding and erection was a major problem.

Because of bad winter ground conditions, all steel was handled by rail. About two miles of standard-gage track was added to an existing siding, and material was stored along most of this length.

In order to have better control of

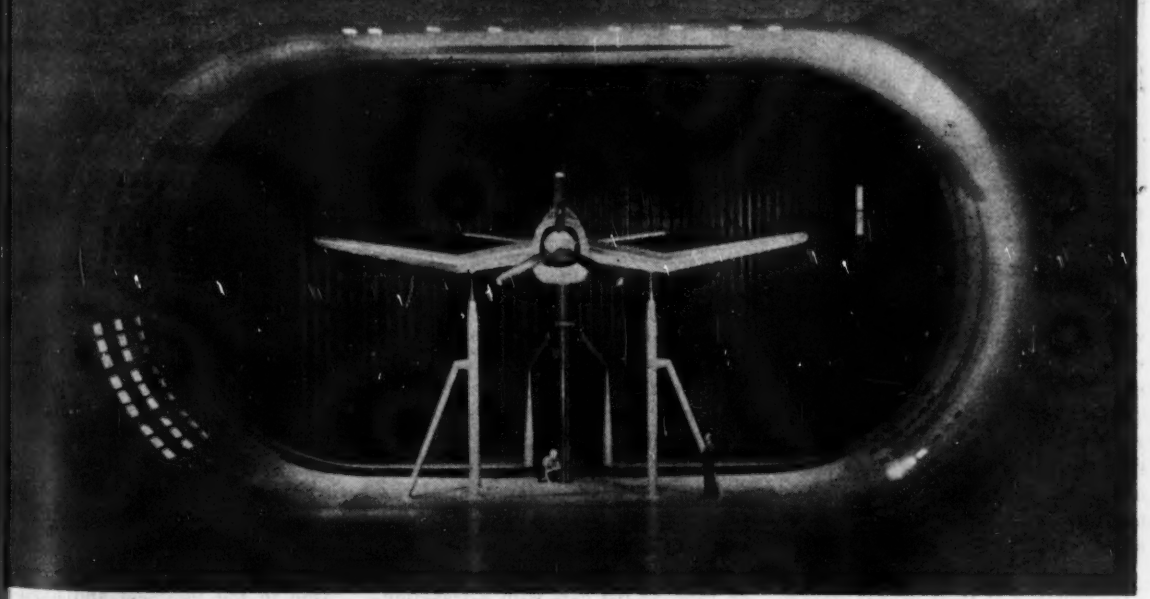


Fig. 3. Huge test section, formed of welded steel plates, dwarfs a Navy dive bomber. Size of the chamber is indicated by the two men. The support system, resting on independent foundations, permits mounting the plane in different positions.

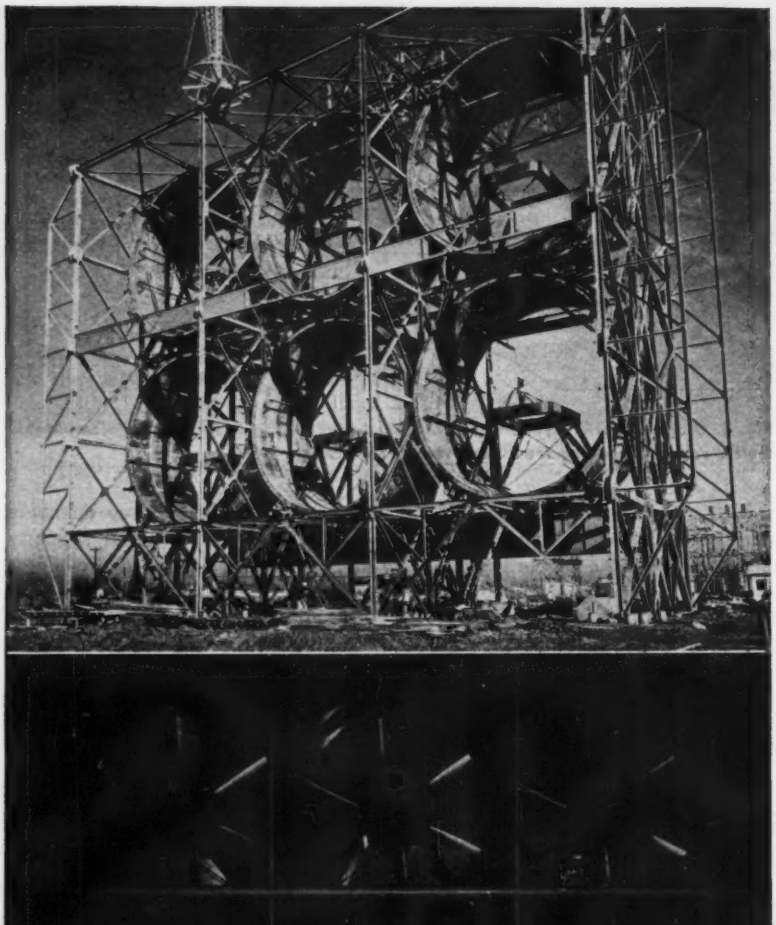


Fig. 4. Heavy framing was required to support the six 40-ft. propeller fans used to generate the wind for testing. Each fan is driven by a 6,000-hp. electric motor.

the detailing, fabrication, storage and erection of the steel, the job was divided into groups, and each group was assigned a designating letter. In making the shop details, each piece of steel was marked, first with the sheet number, next the group letter, then the piece number. Shop schedules and erection schedules were made up by listing each piece in order of erection requirements.

As cars of steel were received, they were switched to their proper storage space and unloaded, and markers were placed showing the shipment number and origin. A drawing of the entire track layout was made showing the area on either side of the track as blocked out. The shipment number as stored was recorded on the drawing, and prints of this drawing were furnished to the yard foreman. From erection schedules made up in advance for each of the three erection rigs, which listed piece numbers and shipment numbers, the yard foreman loaded the proper steel on railroad flat cars with a traveling crane, and the cars were then transported to the proper rig by use of a dinkey engine. During storage, the steel was cleaned with rotary wire brushes after which a shop coat of paint was applied.

Due to the various weights of members, ranging from a few hundred pounds up to 50 tons and more, as well as various heights of structure, a great deal of study was given to the proper equipment to be used in the erection of the steel. It was decided to use three wide-gage traveling stiff-leg derricks mounted on high towers running on double railroad tracks, each powered with three-drum diesel hoists, to be used as follows: One on the east side of the tunnel, one on the west side and one on the center line. The center traveler was worked with either the east or west traveler, or all three independently, in the erection of the major portion of the steel. Each traveler moved on short sections of track and each straddled a material track that extended the full length of tunnel and connected with the storage yard track. The travelers were so designed that by simply jacking up the supporting pins on the rail carriages, the carriages could be turned at right angles for operating on track transverse to the original.

The traveling derricks, designed and fabricated at the contractor's plant in Des Moines, Iowa, were 40 by 50 ft. in plan, 135½ ft. high from the top of the railroad rail to the center of the boom pin with a 125-ft. boom designed for 25 tons in a flat position. Actual erection operations were speeded up by use of telephone systems enabling the yard foreman, the erection superintendent and the derrick operator to be in constant touch with each other.

Erection procedure

The vertical side trusses with bracing were erected with the traveler and then guyed in place. Most of the roof trusses were assembled on the ground by cranes, riveted up completely and then hoisted in place as a unit by two of the travelers acting together. Some of the large roof trusses were erected on steel falsework designed in sections of various lengths with one section adjustable for height. Wedge and ratchet jacks were used to adjust for camber.

Due to the lightness and number of pieces, the vertical girts were erected with small electric hoists

ipped with solenoid brakes and rated with push buttons, which e attached to the steel framing above ground level. The girts e hoisted in place by a single line n these small hoists running over natch block hung from a trolley rating on a light I-beam tempor-ly attached to the bottom chord he roof trusses a few feet inside plane of the wall. Floating scaf-s, telescoping horizontally and ipped with manually-operated ting drums suspended from trol- running on the same I-beam, e used for driving rivets.

careful study was made of the requirements needed to operate ting guns, air jams, reamers, s, chippers, tuggers, rotary wire shes for cleaning steel, grinders, ning hammers, impact wrenches sandblasting machines. It was nd most desirable and economical et up a central power plant and e the air to the various convenient tions and place T-connections nipples, valves and necessary air e connection at the proper loca-s so that air hose could be con-ed at any desired place without of time.

Air power equipment

Within the power house were lo-d three 315-ft. compressors, each ered with a 75-hp. electric motor, connected up so that they would in or out depending on the air and; also one 550-ft. diesel-pow-l compressor. All four compres-were connected to a 265-ft. air iver to which was attached the air main. In order to keep a form pressure at all points on the em, the frictional line loss was efully computed and proper sizes pipe were installed, varying from 8 in. At times the full capacity ll four compressors was needed.

n order to secure electric power he proper points, a 6,600-volt kway cable was run from a sub-ion to a centrally-located trans-ner station where the voltage was ped down. Parkway cable was laid to carry the power to con-ently located panel boards, for rating welding machines, compres-, lights, etc.

While, in general, all field connec-s of the structural work were ted, the platework sections of the el were welded. Plates forming a part of the lining were butt welded, all welds on the inside surface being chipped and ground smooth and flush with the surface of the plates.

As these plates were quite light, $\frac{3}{8}$ in. in the test section and motor rings and about 9/32-in. (11.6 lb. per sq. ft.) elsewhere, no particular problems were involved in their erection and welding. Considerable care was required, however, in securing and maintaining the required accuracy in the test section, a portion of the entrance cone and the 40-ft. rings within which the propellers rotate. These rings had to be true circles within plus or minus $\frac{1}{4}$ in.

Held to close tolerances

All ring girders of the exit section were trammed or checked for size and adjusted to exact dimensions and welded up completely on the ground prior to being erected in place on falsework. The two main ring girders for the test section were located, in the finished structure, 52 ft. apart and, among other things, supported the huge movable doors which opened the full 80-ft. width of

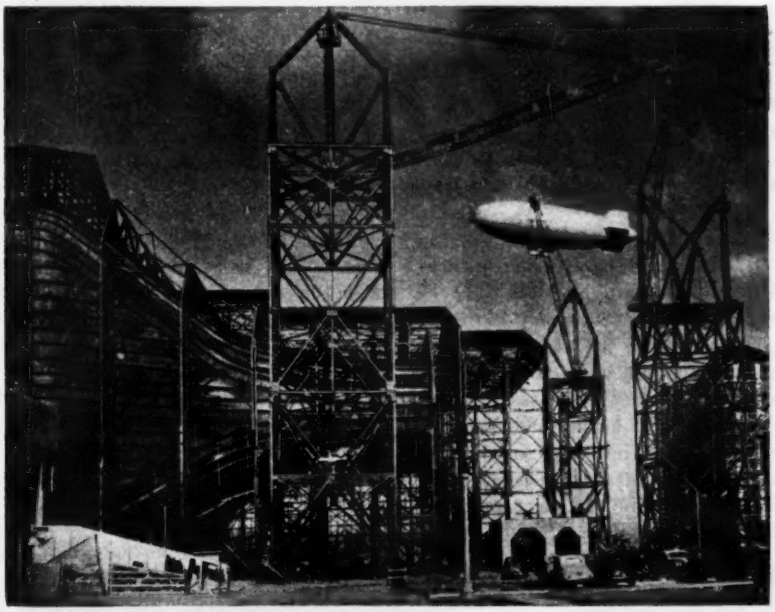


Fig. 5. Three traveling stiffleg derricks on high towers erected most of the steel. The rig in the foreground is working on the oval test section.

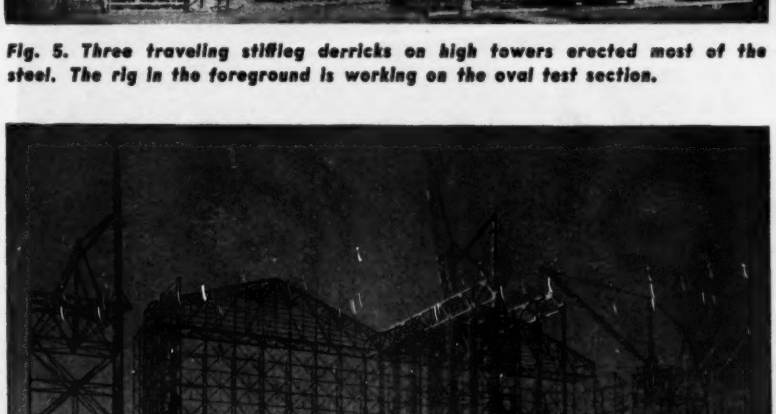


Fig. 6. Steel for the return section framing of the wind tunnel being placed by traveling stiffiegs. Big roof trusses were assembled on the ground and hoisted into place. Vertical girts were erected with small electric hoists.

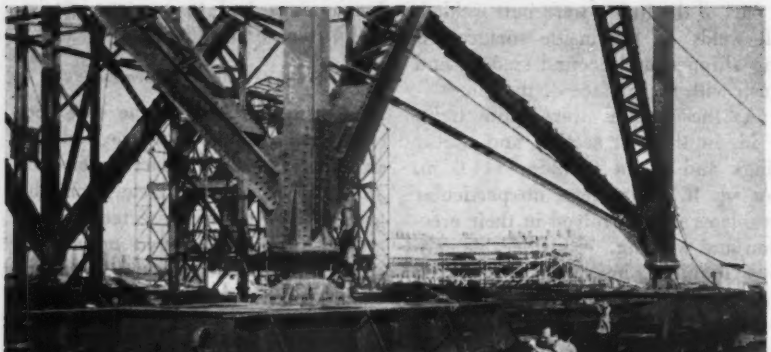


Fig. 7. The derricks traveled on standard-gage rail carriages. Direction of travel of the carriages could be changed 90 deg. by jacking up the tower legs and turning the carriages around the kingpin.

the tunnel test section and for the full distance between ring girders. These doors, weighing 228,000 lb. were worked to extremely close tolerances because they form the upper half of the air passageway for the test section when in closed position. Because of the heavy loads imposed on the test section ring girders, they were of necessity, too heavy to make their erection in one piece practical. They were therefore carefully assembled and trammed on the ground, welded into half ring sections and these set on falsework and welded together. Exacting computations and allowahces were made for the dead load deflections. These computations and allowances were necessarily complicated by the fact that deflections of the rings from the action of the temporary falsework had to be anticipated and allowed for in the erection procedure.

Fig. 8. Steel for the test section had to be set to very close tolerances. Here tramming or gaging of the wall curvature proceeds along with widening operations on the plates. A 15-ft. long flexible batten is used in checking.

The center of all cross sections o the test section were maintained with in the permitted tolerance of $\frac{3}{8}$ in. on a center line established throug the centers of the end sections of th test section. The cross sections of th test section were checked well within the allowable tolerance of $\frac{1}{4}$ in. wit adjustable tram arms mounted on shaft running the full length of th test section on each center line. Thi shaft was supported by adjustabl trunnions attached to transverse beams, all supported on steel bents

The test section and a portion o the entrance cone were further checked for accuracy by using a flexible batten, 15 ft. long, along th inside surface. The finished surface could not deviate from the curve o the batten held tightly against th plate by more than $\frac{3}{16}$ in. at any point, and no local deviation could exceed one percent of its length.

It was found necessary to use a large force of men to remove buckles and flat spots, caused by welding distortion, temperature changes, etc.

Direction of project

With the exception of the drive motors and starting equipment, propellers, balances and testing equipment the Moffett Field full scale tunnel was constructed by the Pittsburgh-Des Moines Steel Co., which also fabricated the steel, about three-fourths of which came from the contractor's plant in Des Moines, and the balance from Pittsburgh. Principal subcontractors were the Raymond Concrete Pile Co., on the concrete piling; Carl N. Swenson Co., San Jose, Calif., on the concrete and building construction; Asbestos Erectors, Inc., Bound Brook, N. J., on cement, asbestos siding and roofing; and H. H. Robertson Co., Pittsburgh, on the steel ceiling and flooring.

For Pittsburgh-Des Moines, Gordon R. Lunt was project manager, C. A. Fegtly project chief engineer and general superintendent, and A. B. Sanderson acted as project coordinator.

The work was done under the direction of the Ames Aeronautical Research Laboratory of the National Advisory Committee for Aeronautics for which Smith J. De France was engineer in charge, with John L. Parsons, representing the contracting officer, and Ferril R. Nickle, head of construction inspection.

The Record of...

Experience With State Building Codes

Contents in Brief—*Believing that enactment of uniform state building regulations will speed modernization of building codes and thus operate to stimulate technological advances and lower costs, several states have such legislation under consideration. Following is a description of the experiences of Wisconsin, which has had state regulation of building since 1911, in administering its code, a summary of the Indiana Enabling Act, enacted early this year, and an account of steps taken in Iowa toward obtaining a state code.*

THE POSSIBILITY of stimulating technological advances in building materials and methods and of reducing construction costs has spurred the drive for modernization of municipal building codes. But progress has been slow, due to the multiplicity of codes and the difficulties involved in revising them. For this reason, some thought is being given to the possibility of speeding modernization of building codes through the adoption of state regulations.

Wisconsin has had a state code since 1911, and experience with it has been satisfactory. Indiana adopted such a code early this year, and similar legislation has been actively promoted in Iowa for some time. The nation-wide situation with respect to state codes was summarized at the Building Officials Conference held at Iowa State College in January by Frank Kerekes, professor of structural engineering, Iowa State College, and chairman of the Iowa State Building Code Central Committee. Prof. Kerekes said:

"Wisconsin, Ohio and Indiana have fairly complete state building codes. Pennsylvania also has rather complete requirements for small cities and detailed regulations for protection against fire and panic, promulgated by the Department of Labor and Industry under authority of state law. North Carolina, South Carolina and Louisiana have somewhat more limited requirements. Massachusetts has state requirements applicable in the absence of local requirements as well as to public assembly occupancies in general. New Jersey has a state code applying to school buildings. In addition, there is a great mass of miscellaneous state legislation applying to industrial establishments and to special features such as fire escapes.

"Even in those states where a fairly comprehensive state building code exists, the coverage is not complete. The application of the code may exclude certain occupancies such as one- and two-family dwellings or it may be limited to municipalities of a given minimum or maximum size.

"Preparation of state building codes has been proposed at various times in Illinois, New York, Virginia, New Hampshire, New Jersey and other states and is being actively promoted at present in Connecticut, Iowa and Mississippi."

Merits of state regulation

Advantages claimed for state codes were brought out in papers presented at the Iowa conference, from which the following notes have been taken:

An important motive in the drive for early enactment of state laws regulating building is the desire to eliminate substandard temporary housing now that the war is over and to prevent jerry-building in areas that lack adequate legal safeguards. At present many communities are entirely unprotected against jerry-builders because they cannot afford to formulate and enforce building regulations. As an illustration of this fact, a survey made recently in Iowa revealed that of 44 cities replying to a questionnaire only 23 have even partial regulations. The survey also disclosed that adoption of a uniform state building code is favored by 43 of the 44 cities.

This desire for state-wide regulation is not limited to communities in Iowa. Far-sighted officials everywhere realize that all communities should enjoy the same safeguards now available only to a few large cities with good codes.

In some cases an argument against state codes is advanced in the belief that such regulation will increase the cost of new construction. While it is true that outlawing substandard construction in areas where such practices are now permitted may increase construction costs to some extent, the overall effect of state-wide uniformity will tend to lower costs. For example, under state-wide regulation the public will have to deal with only one agency and hence will benefit from savings effected through centralized testing and acceptance of new materials.

Administration problems

A state-wide code is said to offer opportunity for nullifying undesirable, local political influence. However, administration of state building laws must be kept entirely free from politics if it is to function properly, according to O. T. Nelson, building engineer, Wisconsin Industrial Commission, who states:

"I am firmly of the belief that the administration of a state-wide building code is definitely not a difficult or insurmountable problem in any state, if it is properly authorized and administered. A code has worked successfully in Wisconsin but I could not definitely predict that such would be the case in any other state unless it could be positively removed from political domination."

For more than 30 years, state building regulations have been administered by the Wisconsin Industrial Commission, which was created by the state legislature in 1911. The commission does not arbitrarily enact rules, but selects for the purpose of establishing regulations an advisory

Fig. 1. The wall of this apartment building gave way during construction. Adequate inspection could have prevented this accident.

committee, the personnel of which is drawn from interested organizations within the state.

Wisconsin code revision procedure

The following is the method practiced in Wisconsin in all code work. Whenever a revision is deemed necessary, the advisory committee is called together and holds as many meetings as are needed to complete the revision. The tentative revised code is then reported back to the commission for the purpose of holding public hearings on the proposed changes throughout the state.

Following such hearings, the advisory committee again meets to give consideration to any and all suggestions or criticism that were brought out at these hearings, after which the revised code is again presented to the commission with a recommendation for or against adoption. Notice of all changes must be made in the official state newspaper, and the changes or revisions that are approved are not effective until 30 days after the date of publication.

The Wisconsin state building code applies to all new buildings and also to additions to existing buildings, except for certain exemptions that include dwellings and outbuildings in connection therewith, apartment buildings used exclusively as the residence of not more than two families, buildings used exclusively for agricultural purposes that are not within the limits of a city or incorporated village, and temporary buildings or sheds used exclusively for construction purposes, not exceeding two stories in height and not used for living quarters.

Except for the city of Milwaukee, where sufficient qualified personnel is employed in the building department, it is necessary that plans and specifications be submitted to the Madison office for examination. However, even though plans are examined by the local authorities, no modifications in state code requirements may be made.

Personnel required to enforce the code includes an office staff of four men and three field inspectors, counting the building engineer who is in direct charge. The office staff examines all plans and conducts all correspondence and interviews, as well as approves of new methods, devices and materials, and makes special investigations where deemed necessary. The field men are responsible for inspections in the three districts into which the state is divided for administrative purposes.

Wisconsin code is flexible

The provisions of the Wisconsin code have the power of statute, the only difference being that the industrial commission may modify code provisions, while statutes require legislative action. Also, since the requirements of a state-wide code may possibly be inapplicable in some ca the commission gives an owner opp tunity to appeal for modification.

For a short time after the W consin building code was adopt considerable difficulty was enco tered in enforcing regulations, p haps because the public considered an intrusion on personal rights. Gr ually, however, resistance was ov come and at the present time effo to enforce the code are scarcely e questioned, due mainly, it is believ to an educational campaign to e plain why such requirements are n essary. Experience in Wisconsin i dicates that an explanation of vari building requirements and why th are necessary has never failed to co vince owners of the desirability such regulations.

The Wisconsin Industrial Comm sion, which administers the st building laws, does not concern i self with purely local matters, a insists only that minimum safe standards of the state be observe The various political subdivisions a privileged to adopt any regulatio of greater stringency that they m decide are necessary to take care their local requirements. As an illu tration of this, officials of the city Milwaukee have been engaged in revision of the city building code. T accomplish this, they use the st code as a basis and add requiremen that solve particular local problem

O. T. Nelson, Wisconsin buildi engineer, is so pleased with the fun tioning of the regulations that holds up the Wisconsin Enabling A as a model for any state considerin such legislation. He reports that least 25 states are interested in t Wisconsin method and that he h sent copies of both the act and t code to that many governors or oth sponsoring bodies. It should b pointed out, however, that inasmu as Wisconsin has only a few cit of considerable size the proble likely to be encountered in other sta may be of entirely different natu and magnitude.

Indiana enabling act

In Indiana an act creating an a ministrative building council, p scribing its powers and duties and a propriating money to carry out work became law in February, 19 The Administrative Building Coun created by the act consists of

embers. Its powers and duties are ested in a three-member committee f the council, called the administra- ve committee, which is composed of e commissioner of labor, the secre- ry of the state board of health and e state fire marshal. The remaining elve members constitute an advisory mmittee, comprised of three regis- red professional engineers, three gistered architects, three building ntractors and three building me- anics, all of whom are required to e representative of the building in- stry and engaged in actual practice nd construction.

Members of the advisory commit- e are appointed by the administra- ve committee, according to recom- endations of any state organizations f the respective architectural and gineering professions, businesses, ccupations or trades, whose mem- ership is the largest of any such rganizations within such respective elds.

Director's qualifications

A director of the administrative uilding council is appointed by the overnor of Indiana to serve for a rm of four years. He is to devote is full time to the discharge of the uties created by the act and also is act as secretary of the administra- ve committee. Required to be a reg- tered architect or engineer qualified the design and construction of uildings, the director is nevertheless rbidden to engage directly or indi- ectly in the practice of architecture r engineering or construction during is tenure.

The Indiana enabling act gives the dministrative committee the power administer all laws relative to the onstruction, repair or maintenance f places of employment, public uildings, tenement houses, and all ther buildings so as to render the ame safe and sanitary. Excepted are rivate residences, and outbuildings n connection therewith, including arns and private garages; buildings sed for agricultural purposes, which re not within the corporate limits f a city or town; or temporary uildings or additions used for con- truction purposes only.

The committee also has the author- y to fix such reasonable standards nd regulations as shall be necessary o carry out the purpose of this act. n promulgating such regulations, the administrative committee may adopt by reference such standards, codes and manuals as are in general use and practice in the building industry at the time and that have been endorsed by recognized technical organizations or authorities for a particular field.

It is the duty of the advisory committee to cooperate with the administrative committee in an advisory capacity. The advisory committee has no authority to issue rules of its own volition, but it may recommend to the administrative committee such regulations as are deemed necessary.

Liabilities under Indiana act

According to the Indiana enabling act, every employer and every owner of a place of employment or a public building shall so construct, repair or maintain such structures, and every architect, engineer or anyone who designs a building shall so prepare the plans and specifications for its construction as to render it safe and sanitary. The administrative committee is authorized to exercise such supervision as may be necessary to enforce the safety and sanitation requirements. The enabling act also provides for punishment of violators.

These rules are to be enforced in cooperation with local officials, including building inspectors of every city. If there be no building inspector, then the mayor, or other executive official, is required by the law to enforce all orders of the committee that are germane to his duties.

All previously issued building regulations have been superseded by a recently issued code. With this new code as a basis, city ordinances may go more into detail if desired, or may contain more stringent restrictions, but in no case may the requirements for minimum safety of the state code be ignored.

A study of the above regulations indicates that the Indiana law has considerable flexibility in that the state building code is prepared by a technical body and can be revised without the necessity of resorting to further legislation. Furthermore, the act simplifies the building code by providing a legal means of referring to recognized standards of quality. Copies of the Indiana state code, which is based on the Uniform Building Code of the Pacific Coast Building Officials Conference, are now available and may be obtained at 50 cents a copy from Prof. C. W. Beese, Head of the Engineering Extension Department, Purdue University, West Lafayette, Ind.

Initiating procedure in Iowa

Considerable activity has been directed in Iowa toward passage of an enabling act for state regulation of building. A brief summary of these efforts is given to indicate some of the difficulties that were faced by the sponsors.

For a number of years, work upon a uniform state building code was sponsored by a committee of the Iowa Engineering Society. A survey was made to determine the degree and extent of interest in such a code in Iowa

Fig. 2. Extension of building regulation into rural areas might have prevented accidents such as the collapse of this warehouse due to overloading.

and it was found that there was practically a unanimous favorable sentiment among those who responded.

Further studies led the committee to conclude that the problem was primarily legislative in nature. Steps then were taken to write an enabling act, in the development of which invitations were issued to other business and professional agencies to join with the Iowa Engineering Society in its efforts.

One contact member was secured from each of 23 different groups having some direct responsibility in the building industry. This council of contact members is now called the State Building Code Central Committee. In order to expedite the work of this group in the event that urgent matters need immediate consideration, an advisory committee was appointed to study problems and to make recommendations to the central committee. However, the power to make final decisions is retained by the central committee.

The principal problem was to draw up an enabling act that was not too restrictive and thus frighten away the support of legislators. A conference was held with Governor-elect Robert Blue to acquaint him with the need for a uniform state building code in Iowa and to present for his information a copy of the proposed enabling act. Also, several senators were contacted, and finally bills for an enabling act were introduced in both houses of the legislature.

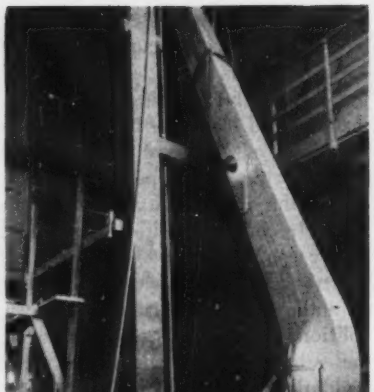


Fig. 3. With responsibility for approving building materials reposing in a single body, economy in testing materials can be effected.

Space does not permit a description of the great number of legislative hurdles that had to be overcome to secure passage of the act. Suffice it to say that on March 22, 1945, the state senate voted for the bill without a dissenting vote. However, the bill got lost in house committees and before it could be extricated, the session ended and the act failed of passage at the very last moment. But the State Building Code Central Committee has announced that it will continue its efforts during the next session of the Iowa legislature.

For further information attention is invited to a symposium of twelve papers that were presented at the Building Officials Conference held at Ames, Iowa, and sponsored by the Iowa State Building Code Central Committee and Iowa State College, in January, 1945. Copies of the symposium may be obtained from Prof. Frank Kerekes, Iowa State College, Ames, Iowa.

Extensive Irrigation Program Planned by Bolivia

Bolivia is planning an extensive program of irrigation projects to increase crop lands and thus free the country from dependence on foreign sources for its food supply, according to reports received by the Transportation Department of the Office of Inter-American Affairs. The need for such a program is evidenced by the fact that Bolivia has only one-tenth of an acre per inhabitant under cultivation against an average of two and a half acres of crop lands per inhabitant in the United States.

The entire program is as follows: Angostura Dam in the Department of Cochabamba, to irrigate 22,000 acres; Rio Viscachani Dam in the Department of La Paz, to irrigate 6,200 acres; Rio Tacaqua Dam in the Province of Chollapata, Department of Oruro, to irrigate 12,000 acres; Rio Desaguadero Dam in the Department of Oruro, to irrigate 15,000 acres; and Rio Pilcomayo Dam in the Department of Tariji, to irrigate 100,000 acres.

First of the projects to be undertaken by the Bolivian Department of Irrigation and far advanced in construction, Angostura Dam will have a capacity of 80,000 acre-ft. It is located about 12½ miles from the city of Cochabamba and is made of mixed rock and earth. Its weir system consists of six 26x23-ft. locks, with a drainage capacity of 70,000 cu.ft. per second.

Angostura project cost $1,260,000

Part of the Angostura project is the auxiliary dike of Santa Cruz from which start the canals for the irrigation of the valley of Cochabamba. Two hydroelectric plants are to be built, one above the auxiliary dike and the other in Alalay. The Santa Cruz plant will develop 2,200 kilowatts and the other, 450 kilowatts. The complete cost of the Angostura project is estimated at $1,260,000.

At a point more than 13,000 ft. above sea level, Rio Viscachani Dam will be constructed at the southern part of the city of La Paz, near the old town of Patacamaya. Rio Tacaqua Dam, near Challapata, southeast of Oruro, at an altitude of 14,000 ft. will be 86 ft. high and will have a capacity of 35,000 acre-ft.

Desaguadero Dam will fulfill two functions: irrigation near the city of Oruro on the Andes Plateau at an altitude of 12,000 ft. above sea level, and improvement of navigation on the Desaguadero River, which flows from Lake Titicaca to Lake Poope. Thought is being given to the possibility of connecting the reservoir formed by the Desaguadero dam with Lake Titicaca, thus facilitating the transportation of mineral ores from that zone.

Rio Pilcomayo Dam will be constructed near Villamontes on the Argentine frontier. With an adequate water supply, it is believed that this zone may be transformed into one of the richest and best situated in Bolivia.

Concrete Piles Jetted to Place By Three-Lead Driver

A CONCRETE PIER for heavy duty recently built for the Navy on the West Coast was located parallel to the shore line and was made accessible by a fill from the shore to the center of the pier. At this location the bottom was fairly uniform, well-compacted sand and gravel. The formation was so tight that wood test piles were driven to refusal with a penetration of only 12 ft. However, with jets concrete piles could easily be put down 18 or 20 ft. and after being jetted to this depth a few blows of the hammer, without use of the jet, would set them firmly.

With these tests as evidence of what to expect, plans were drawn for a wharf to carry a live load of 600 lb. per sq. ft., increased to 800 lb. on the loading platform. To meet this requirement, concrete piles 16 and 18 in. square (those 60 ft. long and over were of the larger size) were located on spacings in the bents ranging from 8 ft. down to 6 ft. 4 in. The bents were spaced 10 ft. on centers.

For putting down the piles a driver with three pairs of leads was built, making it possible to take advantage of the speed in driving that could be made with jets and decreasing time lost in spotting the driving barge. The piles were cast in forms which had a 3-in. pipe down the center and through which water could be pumped at high pressure to provide the required jet action at the tip.

Jetting speeds driving

This arrangement worked out well, it gave the expected speed in getting the piles down to grade and made it possible to accurately predict the required length of piles. This not only avoided waste of materials but also saved the time and labor for cutting away unused pile length. A total of 2,418 concrete piles was used on the job, a large percentage of which ranged between 50 and 80 ft. in length. Piles were driven at a rate of 24 to 30 per 10-hr. day to an average penetration of 18 ft. The pump, mounted on the driver barge, delivered 400 to 500 gpm. at pressures of 250 to 300 psi.

The piles were cast in a yard on tidewater at a location where labor was less costly than at the pier and from which delivery by barge to the site was relatively inexpensive. Because of the desire for speed, steam-curing methods were used in the casting yard and piles were jetted seven days after casting. Barge loads of piles, ready for jetting, were delivered alongside the driving barge where a revolving crane picked them up with a three point support and placed them in the leads. This same crane handled the automatic steam hammer used for driving the final few feet after the pile had been jetted down almost to the required grade.

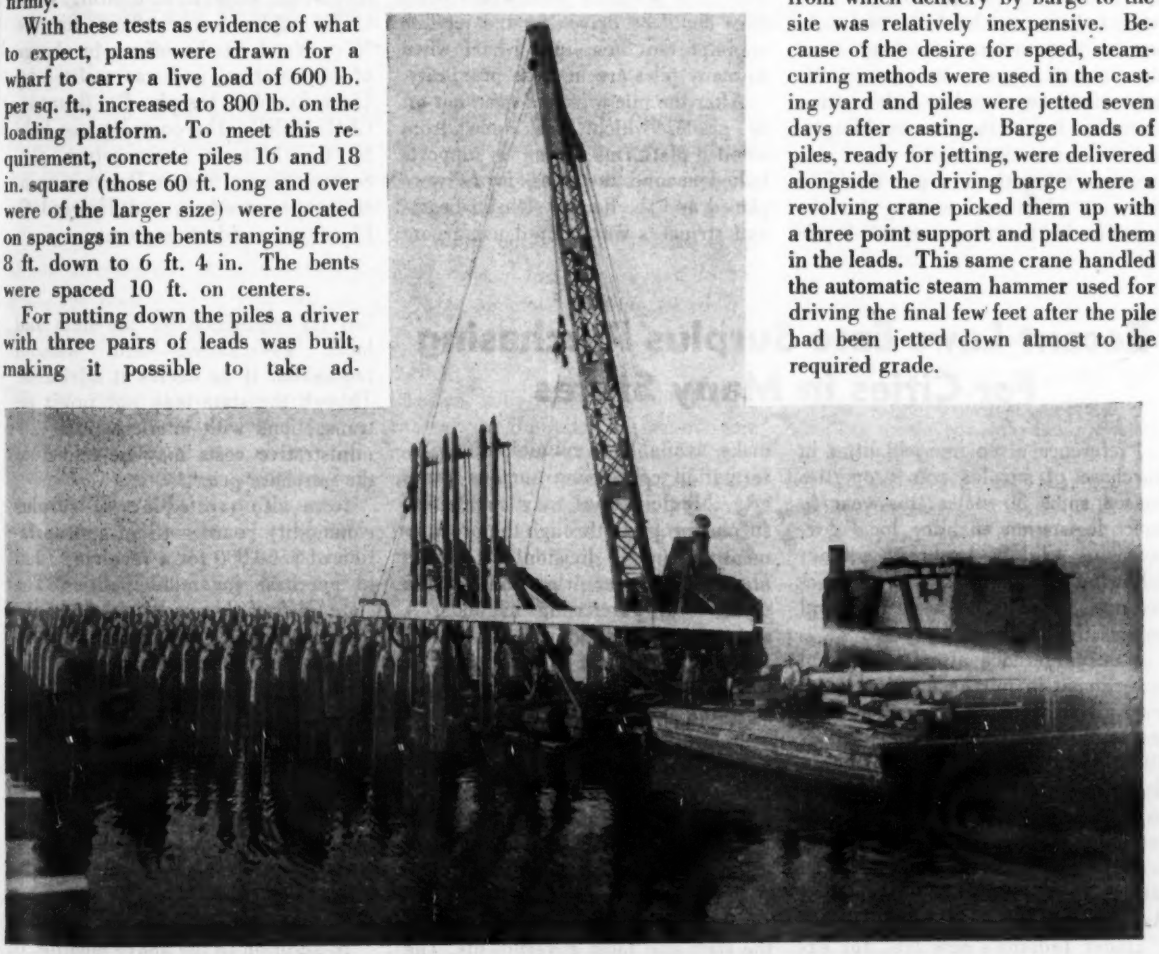


Fig. 1. Water pressure clears the centrally located jetting pipe prior to placing pile in one of the leads. Note close spacing of piles and arrangement of leads to permit driving three piles from one location.

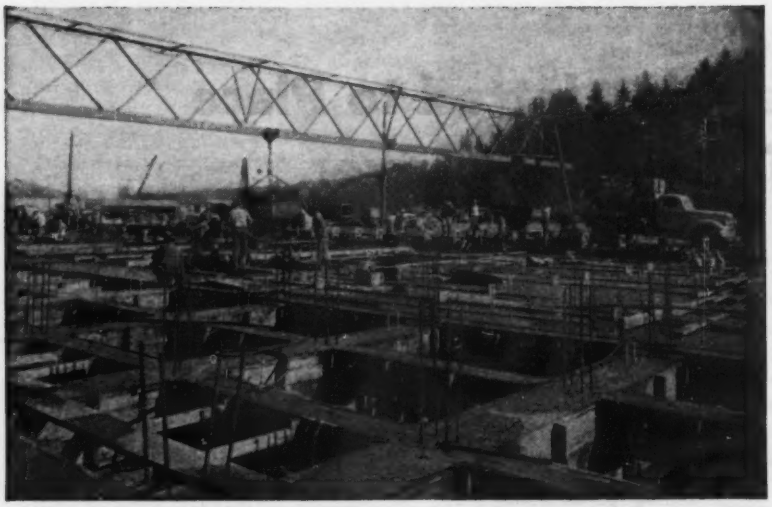


Fig. 2. Steel bridge spanning the pier deck carried concrete bucket on monorail to speed delivery from mixer truck.

For each move of the driving rig three piles could be placed, thus materially reducing the amount of time spent in lining up the drives and making for very accurate spacing. Once the driving rig was in position the piles could be placed and the jetting started as fast as the crew could operate the crane that swung them into position. Often the first pile would be down in place and waiting for the hammer by the time the third pile was in the leads so that the crane could be released to handle the hammer. The accuracy with which these piles could be driven by the jet was an important item in a wharf when so many piles are in close proximity.

After the pile tops had been cut off to grade, which was done from wooden platforms resting on supports bolted around the piles, forms were placed and the floor system of beams and stringers was poured using concrete mixed in a central mixing plant from materials delivered by barge. The concrete was conveyed from the plant to the forms in truck-mounted mixers with a gravity discharge to skips. The skips moved across the pier on an overhead monorail suspended from a 98-ft. gantry truss spanning the full width of the pier. The bottom chord of this truss cantilevered beyond the supports at one end, thus enabling the skip to roll into position out over the truck roadway to receive its load from the mixer-truck. The floor slab was placed in a separate pour after completion of other parts of the floor system.

The pier was built under the direction of the chief of the Bureau of Yards and Docks, Vice Adm. Ben Moreell, CEC, USN. Rear Adm. C. A. Trexel, CEC, USN, is the superintending civil engineer for Areas VII and VIII, and represents the chief of the bureau in this area on all construction work. Capt. E. B. Keating, CEC, USN, public works officer for the Navy Yard, is the officer in charge of construction, and was assisted by Lieut.-Comdr. Joseph C. Bronson, CEC, USNR. The contract was held by the Manson Construction Co., Seattle, Wash., Walter Peterson, general superintendent, and Howard C. Flanagan, resident engineer.

Recent Laws Ease Surplus Purchasing For Cities in Many States

Preference given municipalities in purchase of surplus war properties caused some 30 states this year to enact legislation enabling local governments to buy surpluses without following usual municipal buying procedures involving advertising and competitive bidding.

First preference after the federal government in purchase of surpluses was given state and local governments by the surplus property act of 1944. Most of the 1945 legislation designates a state purchasing agency to act as coordinator and distributor for municipalities in surplus buying, according to a survey of state legislation by the American Municipal Association.

Under Indiana's new law, for example, the state director of procurement and supply on request must make available to municipalities information concerning surplus property. Municipalities may requisition surplus property through the procurement and supply division if it can be obtained at lower prices than by the usual local purchasing methods. A state revolving fund was established for the purchase of surplus items.

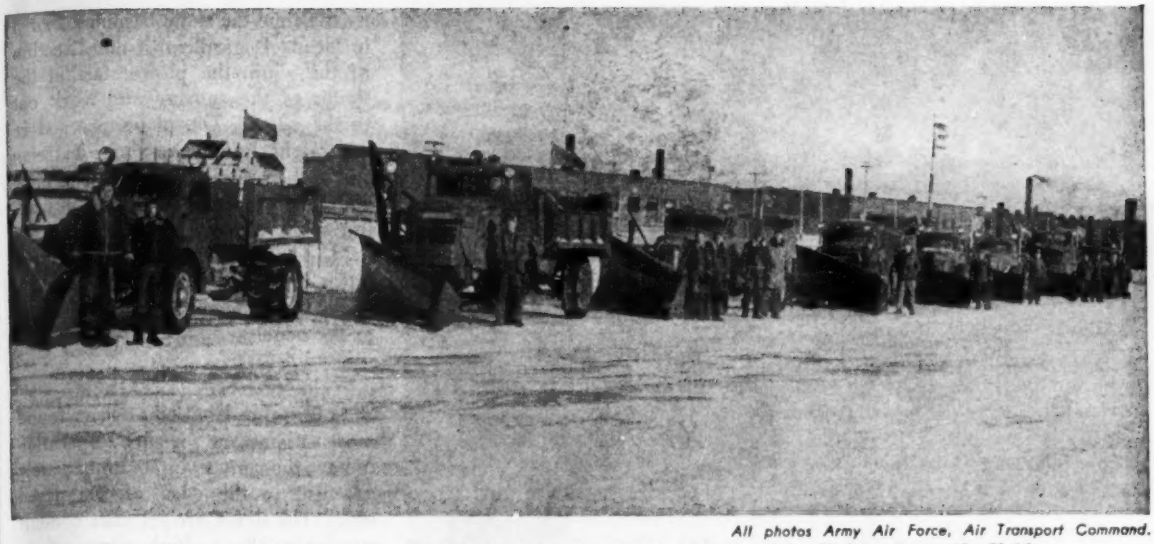
In Maryland, under new legislation, the state council of defense set up a war surplus property division to help municipalities buy war surpluses. The agency will coordinate activities of federal disposal agencies and municipalities, but will not make actual purchases or handle property.

Washington created a $5,000,000 revolving fund to buy surpluses for the state and local governments. The fund is administered by the state director of finance, who is permitted to buy on requisition for the state and local governments—and without requisition if he deems it advisable. Though the state may not profit on transactions with municipalities, administrative costs may be added to the purchase price.

Iowa also created a war surplus commodity board with an appropriation of $500,000 for a revolving fund to purchase for municipalities. The state also will warehouse and distribute surpluses donated to cities.

Included in the states passing this type of legislation were Arkansas, California, Colorado, Connecticut, Delaware, Florida, Idaho, Indiana, Iowa, Kansas, Maine, Maryland, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New Mexico, North Carolina, North Dakota, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Vermont, Virginia, Washington and Wisconsin.

In addition to the above-mentioned states, four others enacted similar legislation last year.



All photos Army Air Force, Air Transport Command.

Fig. 1. Plows are the first line of attack in snow handling at Presque Isle, Maine, Army Air Field.

Clearing Snow at a Northern Airbase

***Contents in Brief** — Plenty of snow-handling equipment, operated by regularly assigned enlisted personnel under direction of the post engineer has kept the Presque Isle airfield in northern Maine always ready for traffic. Trucks with one-way plows do most of the work with blowers used to boost the snow over the runway lights where the plows again push it to the edge of the safety strip. A plow with a powered vane in the wing is used to cut down the final bank left by the plows. Notes on snow handling at several other northern fields are appended.*

ONE OF THE FARTHEST NORTH airbases in the continental United States, Presque Isle, Maine, has never been blocked by snow despite a seasonal fall of as much as 108 in. and a seven-hour storm of 12 in. during which half the fall occurred in a 2-hr. period. Principal factor in successful snow clearing has been adequate equipment, but of paramount importance has been the availability of experienced and regularly assigned personnel.

Presque Isle Army Air Field is a most important link in the Air Transport Command's "Snowball" route to Europe. It is the last field before the Atlantic hop where United States planes can be given major repairs and is the field they can most easily reach when returning. It is outside the foggy New York-Boston "Weather-Area" and so is seldom out of service from that cause. Due to its strategic location, it has been essential that the runways be kept open despite extreme cold and snow conditions. Consequently, sufficient equipment has been assigned to the field to clear it quickly. In three years of operation, no plane has had difficulty in landing due to ice or snow conditions on the field.

Equipment assigned includes many varieties of plows and three types of rotary snow throwers. Because of the extremely long season of snow, Presque Isle frequently has been designated as a testing ground for newly developed snow handling equipment. The latter has included units of a much larger size than are now in common use.

The field at Presque Isle has three 150-ft. wide runways, the longest being 6,800 ft. Four large hangars are dispersed around the field and large areas are provided for hardstandings and aprons. At one time, 160 B-17's and B-24's were "parked" on the field in addition to regularly assigned craft. The area that is cleared completely of snow is about 1,250,000 square yards, which includes 150 ft. each side of the runways and a wide strip along the taxiways to assure maximum safety of operation.

Plows in echelon formation

Except for lifting snow over the runway lights, the major part of snow handling on the runways is done with one-way, right-hand plows, as many as ten of them operating together in echelon formation at a speed of 15 to 25 mph. Plowing ordinarily is started as soon as there is enough snow to pick up on the blade, always before as much as 2 in. of snow has accumulated. It is carried on with all equipment available working at utmost speed so that by the time the snow fall diminishes to the extent that visibility permits landings or take-offs, the runways are ready.

Trucks used to push the plows range from 5 to 8 ton with most of them driven on all wheels. The two-wheel drive, lighter trucks are used at the left and in the lead with size of blade and truck power increasing progressively to the right. The larger trucks, 7½ and 8-ton, are equipped with wings.

Fig. 2. Huge windrow built up by plows is thrown well off the runways and aprons by rotary blowers.

Each truck takes the maximum "cut" that it can make and keep up to speed in the formation. If a unit drops back the driver merely moves over a little so that the blade gets less snow and thus is able to speed up to position. This is essential when snow is driving and it is difficult to see for any distance. Also, close formation is of utmost importance when it is possible that a plane may require use of the runway and it is necessary to get obstructions out of the way immediately.

Plowing is done first on the runway where wind will be prevailing by the time the snow becomes 2 or 3 in. deep. Regardless of the direction of the wind, the plows start at the center of the runway and work out to the edges. The plows proceed in a straight line beyond the extreme end of the runway, then stop and back a little before turning, to prevent leaving a pile of snow at the end of the field. The echelon of plows then goes down the other side of the runway, again throwing snow from the center to the edge.

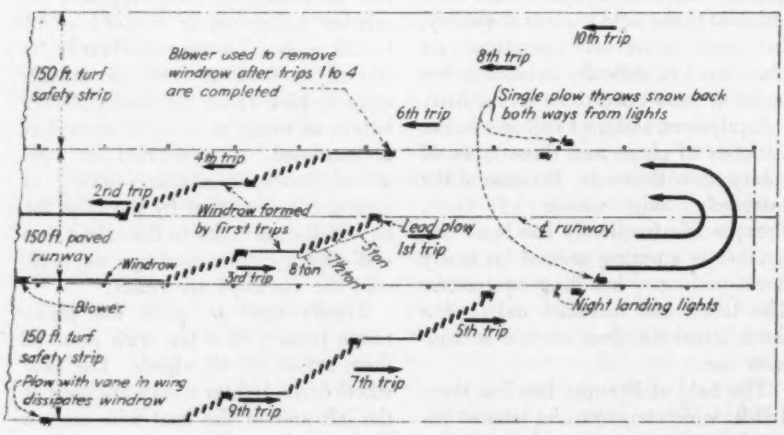


Fig. 3. Plows in echelon push the snow to the edge of the runway where it is picked up and thrown over the lights by a rotary unit. Plows are again used to throw the snow to the edge of the safety strip where the windrow is dissipated by a plow with powered vane in the wing.

Plow along runway lights

At Presque Isle, it has been found most satisfactory for plane operation to have the runway lights immediately adjacent to the edge of the paved strip. The lights are on fiber conduit standards 18 in. high arranged so that if they are struck by a plane or a plow, they are instantaneously and completely detached without endangering the plane and with a minimum of damage to the lights.

At the time the echelon of plows starts on the center of the runway, a single plow takes a leisurely swath along the inside of the lights, turning the snow *inward* onto the runway. This plow then makes another pass on the outside of the lights again throwing the snow away from the lights so that the row of lights is clearly defined. This cleared area along the lights on each side of the runway may be widened by another pass of the plow.

Meanwhile the echelon of plows is continuing to make round trips on the runway pushing the snow to the small windrow thrown back from the lights. As snow accumulates, the 15 to 25 mph. speed of the plow is maintained by reducing the width of the cut that each plow takes. Two, or at most three, round trips of the plows are sufficient to clear a runway, the entire job taking about 40 min.

Avoid piling the snow

Next, the echelon of plows moves to the area outside the runways and starts again to move the snow outward, leaving the windrow of snow piled up from the runway, plowing on the edge of the runway just inside the lights. One or two round trips of the plows on the safety strips on alternate sides of the runways moves the snow that has naturally fallen on this area to a distance of 150 ft. from the edge of the pavement.

At this stage big rotary throwers come into action for the first time. Moving slowly, they throw the windrow of snow remaining on the runway over the lights and out on the safety area just plowed. It has been found faster and more economical to plow the area outside the lights before the snow from the runway windrow is thrown over it and then to plow it again afterwards, rather than pack the natural layer with snow from a rotary snow thrower and try to move all the snow at one time.

After the plows have made the final push to the edge of the 150-ft. width along the runway, it has been found desirable to make the last pass with a heavy truck equipped with a plow and a wing that has a powered vane near its end designed to boost the already moving snow off the wing and far beyond it. The wing also breaks down the bank, eliminating the abrupt height, which tends to cause drifting.

Plow blades that have given greatest satisfaction under conditions existing at Presque Isle are moderately high, smoothly rounded one-way type units, operated at moderately high speed. V-blades have not been found necessary or very satisfactory for airport runways; even roads around the camp have been kept open without difficulty by a one-way blade, so long as the snow is not permitted to drift deeply.

Scrape to bare surface

Methods of snow handling followed at Presque Isle are predicated simply on what provides the safest field conditions the greatest part of the time. Snow is plowed off down to the runway surface, the blades riding on shoes adjusted to the closest possible clearance on the runway surface. This wears out blades much more rapidly than supporting them well above the pavement but the resulting very thin layer of snow quickly blows away or melts, leaving the runway entirely clear. Sweeping the runways with rotary brooms just prior to start of the snow season helps to reduce the foreign matter than might interfere with snow handling.

Plowing down to the surface is done also on the 150-ft. safety strips on each side of the runways. Such plowing is done only after the ground freezes and is stopped when the frost is coming out of the ground in early spring because, in the event the ground is soft, the ruts made by the trucks spoil the sod and create more of a hazard to a plane that might veer off the runway than would well distributed snow. On frozen ground, the plows operate smoothly and without damage to the grass. The safety strips of frozen sod, swept clear of snow, provide usable additions to the runways.

Fig. 4. Lieut. Ralph K. Heinze, assistant post engineer at Presque Isle, holds fiber conduit supported runway light to show ease of detaching and simplicity of replacing in the event that it is hit.

Intensity and duration of a storm affects the procedure at each snowfall to the extent that snow handling never becomes routine. Preferred procedure is to entirely complete one runway before proceeding to the second. Frequently, however, additional plowing beyond the lights is left for a later operation, while the other runways are put in serviceable condition and snow on taxiways and around hangars is moved out of the way.

Intersections are difficult

If the full runway can be completely cleaned, right-angle intersections with other runways present little difficulty. Oblique-angle intersections are bad and frequently require loading of the snow for removal from the immediate area, though carefully planned use of plows and blowers will move most of the snow more quickly and cheaply. At Presque Isle a circular path for the plows has been effective in cleaning the intersections but requires that the ground be frozen so snow can be pushed well away from the central area.

Parking areas are as much as 800 ft. wide. When snow storms are intense it is not always possible to commence plowing on them until possibly 4 or 5 in. of snow has fallen. When this occurs the usual procedure is to divide the width into quarters; the two outer quarters are plowed first—the snow being moved to the outside of the level area where it is boosted out of the way by rotary snow throwers. Each of the center quarters is then plowed to the outside of the parking area where it in turn is blown away from the used area.

Around hangars and on some of the parking areas and runway intersections some of the snow is loaded and

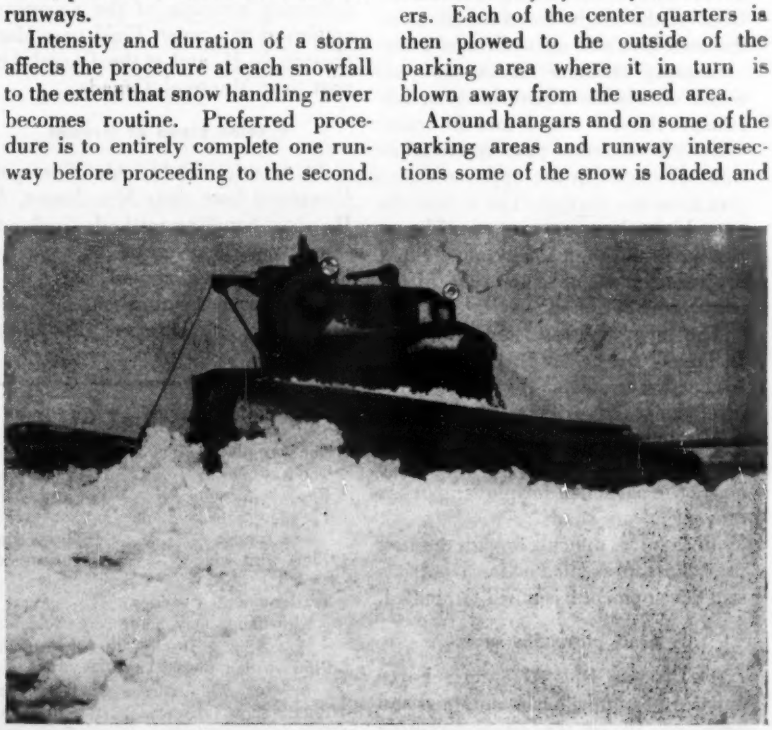


Fig. 5. All wheel drive is essential on trucks pushing big plows and is desirable for any size plow, as it counteracts side-thrust from the snow.

hauled away for disposal. Loading is done by small rotary snow throwers equipped with a hood to direct the snow into a truck.

Plowing immediately before the snow is packed and getting down to the surface with the plows has prevented hardening of snow into ice. The area ordinarily is free from sleet or ice storms, so skid prevention has not been a problem. Patrol-graders available at the field are used to loosen ice that may form, and small sanders are occasionally needed to spread untreated abrasives over inconsequential smooth areas.

Bigger equipment tried

Experimental use has been made of some large snow throwers that have possibilities of developing into useful units. One of these units weighs 30 tons and in addition to the regular truck motor, utilizes two 350-hp motors for snow handling alone. A screw pulls snow into a powerfully driven fan that throws it a long distance.

The truck unit is arranged to operate in reverse with the plow and dual motor unit built in one piece and set over the tandem dual rear wheels thus doing away with remote drives and heavy equipment cantilevered far in front of the single front-wheels as in the usual powered snow thrower units.

Steering is done on the conventional wheels but these wheels in this case are the rear wheels and the transmission is altered to provide the selections of speeds in the opposite direction from the normal. The driver sits at a high elevation over the blower and steers through long controls that are reversed to make the turn of the wheel conventional.

The integral motor and plow unit is hinged just back of what normally is the driver's cab. A pair of powerful hoist arms mounted over the tandem-dual wheels lift the rear of the unit to give proper clearance above the pavement for plowing or for movement on roads.

Mechanical difficulties with the first unit built prevented extensive trials and development has now been halted.

Army plows the snow

At Presque Isle, Army Air Force enlisted personnel has maintained and operated all of the snow handling equipment under the direction of the post engineer forces, who are responsible for snow handling and all other maintenance on the base. Regularly assigned personnel has been 36 men, some of whom have worked on snow handling for the three years that the field has been an important base. Being part of the Air Force, they have developed an esprit-de-corps that has been a major factor in always having a place ready for planes to land or take off.

EQUIPMENT FOR SNOW HANDLING AT PRESQUE ISLE ARMY AIR FIELD

2 Rotary snow throwers	7½-ton truck
2 Rotary snow throwers	5-ton truck
5 Rotary snow throwers	2½-ton truck
3 Plows with powered vane in wing	8-ton truck
2 Plows with wing	7-ton truck
2 One-way plows	7½-ton truck
5 One-way plows	5-ton truck
2 Patrol graders	
1 Crawler tractor with V-plow	

A weather forecasting service is maintained at the field, primarily for the fliers but also serves the the engineer forces. This service has been very accurate in forecasting when snow would start, but it has had less success in telling just how long a snow storm will last, how "wet" it may be, and how much snow will fall.

When the forecasting service reports that snow is expected, the crews are advised and sometimes are sent home to rest until they will be needed. Plans are made for best disposition of equipment and any final servicing of machines is completed. Plowing operations frequently have required round-the-clock work. Where it is expected that snow will be continued, the crew works in shifts, but the usual working period when snow is falling is a minimum of 12 hours.

For the past three years the snow handling at Presque Isle has been under direct supervision of Lieut. Ralph K. Heinze, assistant post engineer. Capt. Miller now is post engineer, succeeding Maj. Southworth in that position.

SNOW HANDLING AT OTHER AIRPORTS

Additional useful information on means of keeping airports safe for winter operation is provided in the following accounts of the procedure employed at Grenier Field near Manchester, N. H. and at the Dorval Airport near Montreal, Canada.

Echelon plows at Grenier

At Grenier Field, Air Transport Command base near Manchester, N. H., snow-handling methods similar to those used at Presque Isle are followed. Average annual snowfall is less, however, being about 60 to 80 in. per year. There are three principal runways each 150 ft. wide, and averaging more than a mile in length. Shoulders along the runway have a surface treatment of tar for an additional 75 ft. each side of the runway.

EQUIPMENT USED AT GRENIER

5 One-way plows	2½-ton truck
4 One-way plows	5-ton truck
2 Plows with wing	7-ton truck
1 Plow, underbody blade and sander	9-ton truck
1 Plow with wing	5-ton truck-tractor
1 Trailer-mounted sander with under-body blade	(used with truck-tractor)
2 Plows with powered vane in wing	8-ton truck
4 Rotary snow throwers	2½-ton truck
1 Rotary snow thrower	5-ton truck
1 Rotary snow thrower	7½-ton truck

The procedure followed is to start operations as soon as there is snow enough to plow, using six or seven one-way plows in echelon. Lighter plows take the lead with successively heavier units following, all working to throw the snow from the center line of the runway to each side. For the usual falls of snow, up to about 6 in., the snow is plowed out to the edge of the surfaced shoulder. The runway lights, set at the edge of the runway, are passed by weaving in and out at each light.

Heavy falls of snow are plowed to a windrow at the lights. The shoulders are cleared separately, the windrowed snow from the runway is blown across the light onto the cleared area and the shoulders are again plowed. Conventional blowers and the type with a vane in the wing are used at Grenier, the latter concentrating on windrowed snow on the field while the conventional units are sometimes used for loading around buildings.

At the corners of runway intersections, very large piles of snow ac-

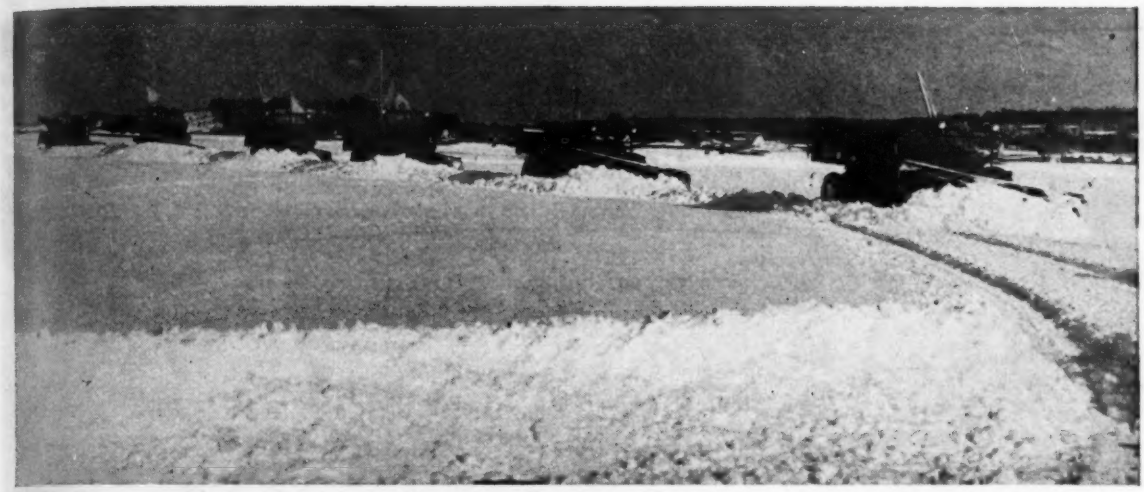


Fig. 6. Plows in echelon push snow to one side of runway at Grenier Field. Note that heavier plows at rear all are equipped with wings but ordinarily they are not used in high speed echelon plowing as every effort is made to keep the snow from getting deep enough to make them necessary.

cumulate as the season advances and periodically this is hauled away by dump trucks, loaded by an overhead shovel on a 5-ton tractor.

Runway lights at Grenier are mounted for normal use in a rubber base set just above the surface. The unit is arranged so that if a plane runs over it the receptacle unit is mashed down, usually unharmed, into a recess below the surface. For winter operation the light receptacle is attached with a long cord and is raised to about 3 ft. above the pavement where it rests on a truncated pyramid built of light plywood painted bright chrome yellow.

This frame supports the light where it can be seen despite any condition of snow. It is made of light wood so that if a plane or plow strikes it the box collapses. Usually the cord connecting the receptacle to the circuit pulls out of a socket provided for that purpose and there is no damage to the light. Consequently the only repair needed is to replace the wood box.

The plows scrape down to the pavement surface but occasionally a little ice develops that requires sanding. A very small amount of calcium or sodium chloride is added to the stock pile of sand to prevent its freezing.

Packed snow at Montreal

At Dorval airport, near Montreal, operated by the Dominion Government, Department of Transport, a 1½-in. layer of packed snow is maintained all winter and snow is plowed from the surface of this rather than from the pavement.

Three medium trucks with one-way plows, a heavy truck with blade and wing, a unit with a powered vane in the wing, five rotary snow throwers, two patrol graders and some small bulldozers are used on the field, which has three 5,200-ft. runways. The light plows are used in the lead with heavier plows followed sometimes by blowers. The latter are used quite largely however to load snow from hangar and apron areas where it cannot easily be plowed.

The ice cover makes the surface slippery and sand is used to reduce skidding. Sodium or calcium chloride with the sand is not permitted due to possible corrosion effect on planes. Heating the sand to make it stick on the runways has been tried but it has been found difficult to get it hot enough and keep it hot enough to embed in the ice on the runway. A fine water spray, supplied by a pressure distributor, has been tried with the expectation that it would freeze and hold the sand. This idea has not yet been proven wholly successful.

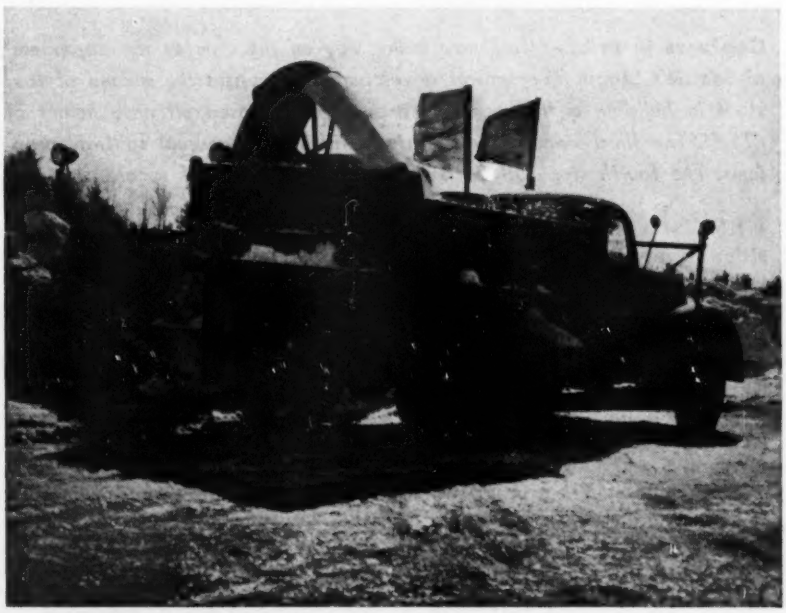


Fig. 7. Where snow can't be thrown out of the way it is loaded by hooded blower and hauled away.

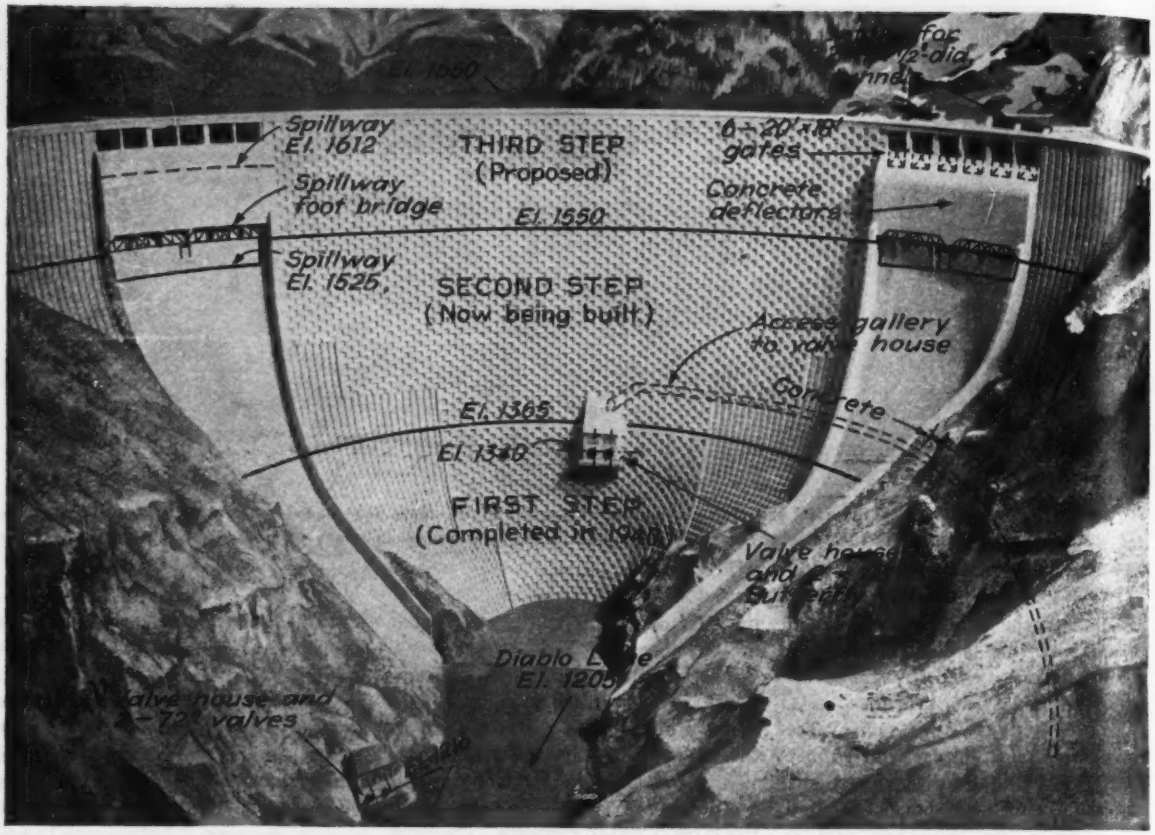


Fig. 1. Artist's conception of appearance of Ross Dam after first three steps are completed.

Raising Ross Dam to 475-Ft. Height

***Contents in Brief**—Work now under way on the dam at the upper end of Seattle's Skagit River power development comprises the second of four steps in building a thin concrete arch to a proposed ultimate height of 675 ft. The third step, not yet started, will involve unusual spillway problems. The fourth step will be a concrete-bonding job of record size.*

ROSS DAM, the uppermost of Seattle's hydroelectric developments on the Skagit River, is in a location where reservoir storage greatly increases the annual power output of the system. The dam is named after the late J. D. Ross, for many years superintendent of the Seattle Department of Lighting, who long ago had the foresight to survey the upper Skagit and plan a development program that would make the most efficient use of the river's power. His program culminated in this uppermost damsite (then called the Ruby project) that would create a reservoir extending beyond the Canadian boundary.

The three sites on the Skagit where the Ross plan located power developments are Gorge, Diablo and Ruby (now Ross). These were to be developed successively in this order, on the unit construction plan, adding generating units or increasing storage as the demand for power increased. The uppermost of the three plants has a most unusual damsite. It makes possible a structure of record height at relatively low cost. The great amount of storage created by the ultimate height of this dam will greatly increase annual power output from all three plants.

Construction of the two lower dams, built years ago, was difficult enough because of the rugged terrain of the Skagit canyon country but they were easy as compared to the obstacles to be overcome at Ross Dam. Here the canyon affords practically no space for plant or camp. Diablo Dam, the one next below, backs water up to the toe of Ross Dam, thus entirely flooding out the streambed so that the only available working spaces are narrow benches on the precipitous walls of the canyon which rise sheer for hundreds of feet.

Problems at Ross Dam

The first step in the construction of Ross Dam was carried out early in 1940. Wartime demand for power in the Northwest hastened the time for undertaking the second step and this was begun in 1943. The objective was the additional water storage that would add 300,000,000 kw.-hr. an-

nually to the output of the Skagit project as a whole without need for more generating units.

The problems to be met in carrying on further construction work at Ross Dam were well understood from experience with the first step. However, present operations involve the additional difficulties imposed by wartime. The remote location is an important factor, not so much because of the distance in miles but rather because of the transshipments required in changing from one form of transporation to another. All freight has to come up the river. There is no other route. There is no highway to Diablo Dam because there is space for only one line of travel up the canyon and that is occupied by the city's private railroad. After the long trip to Diablo the freight is raised in a lift over Diablo Dam and then is again transferred, this time to barges, for a water trip lengthwise of the lake that extends upstream to Ross Dam.

This remoteness has its effect on manpower as well as on handling freight. Labor turnover is a serious problem despite a high wage rate, good food and unusual care in providing attractive quarters. Because of the time required to get from the job to Seattle the program is 12 days of continuous work followed by a 2-day rest period that makes it worthwhile to travel all the way to town. Weather is also a factor in the labor situation because of the 74-in. rainfall and the amount of cold, wet weather. The job has been carried on with less than half the number of men needed for working to best advantage.

Although there are two other power plants below Ross Dam, Diablo is the only other dam. Gorge plant, the lowest of the three is served by a tunnel at whose intake there is only a diversion weir that creates no storage. Ultimate plans call for a storage dam where the weir now stands, to make use of the head in the stream between that point and Diablo plant. When this has been done, water discharged from Gorge plant will have delivered the maximum of hydroelectric power available between that point and the upper end of Ross Lake in Canada. This ultimate total is estimated to be 1,120,000 hp.

Because of the proposed height of Ross Dam and the consequent risk of damage to the thin arch structure if the sheet of water pouring over the spillways were not properly controlled, particular attention was given to a study of spillway control gates for the third step. Two limitations, it was realized, would make it difficult to work out a simple design for the devices to accomplish this. First, the dam will be of insufficient thickness at the crest to permit construction of a true vacuumless overflow section and, second, there was a prohibition against cutting into the dam below El. 1,600 because of the need to provide for stress in the arch.

When the dam was built up to the height of the first step, water was permitted to pour over the crest freely at any point. In the second step, in high water emergencies, there will be no over-pour since the capacity of the partially completed rollways at the two ends will be ample to carry the estimated maximum flood. While the dam remains at third-step height, the flow over the spillways at either end of the dam is to be controlled in such a way as to keep the flowing sheet of water close to the surface of the concrete. The design was worked out to give a maximum of protection against vibration and impact.

When the fourth step is completed there will be no provision for flow over the crest. At that level the reservoir will be of such extent and the fluctuations of the surface level will be so slow that it should be possible to operate the valved outlets through the dam in such a way as to avoid much if any spillage. Nevertheless an ample spillway of simple overpour type will be built around the left end of the dam, making use of a ravine that empties into the river below the powerhouse.

In designing overpour control at the top of the third step, at which time the dam will be 575 ft. high, it was realized that conditions would be encountered for which there is little precedent. Careful investigation was therefore planned and arrangements were made for a series of model tests.

Fig. 2. Ross Dam is 95 mi. northeast of Seattle, air line.

Fig. 3. Construction on Ross Dam, as of last fall. First step completed, work on second under way.

For these tests two hydraulic models of the Ross Dam spillway were built and conditions were set up to simulate a reservoir surface at El. 1,630. The dam was considered as an arch 33 ft. thick from El. 1,600 to the crest. Experiments began with the assumption that in no case should the water flowing over the crests be allowed to spring free from the downstream face of the dam and impinge on the rock or concrete below. It was planned to keep the overfalling sheet in direct contact with the downstream face for all conditions of flow, to provide a heavy bucket at the junction of the dam and rock surface to turn the jet, and to provide a superelevated channel downstream from the bucket to conduct the flow to the river.

Preliminary trials were made with a model built on a 1:60 scale with provisions for the equivalent of a 70,000-sec.-ft. flood controlled by twelve 25x22-ft. Monocoque gates. Then an overflow section was constructed on a 1:25-ft. scale equipped with sufficient piezometers to study pressures on the overflow face as well as on the inner surface of a deflector hood built over the gates, as shown in Fig. 6. The deflector hood was tried out with flows simulating a discharge of 100,000 sec.-ft. on the prototype.

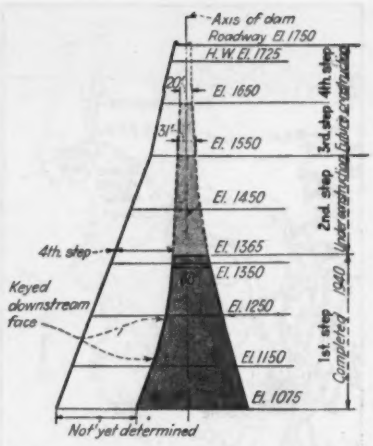


Fig. 3. Crown section through Ross Dam showing the four successive steps.

This second model effectively demonstrated the important part that could be played by a deflector hood at practically all flows. The tests confirmed the plan to incorporate this design in the prototype. Final adjustments, made with the models after the preliminary tests had fairly well established the details, aided in reaching decision on design details. For example, it was found possible to limit negative pressures to one-half an atmosphere. The maximum positive pressure on the deflector was recorded at a discharge equivalent for 80,000 sec.-ft. This maximum was the equivalent of a 15-ft. head.

The twelve 25x22-ft. gates were set downstream from the crest, as shown in Fig. 6, so that the initial velocity would be downward rather than horizontal. The portion of the overflow section upstream from the gates was designed to produce no sub-atmospheric pressures in this region for discharges up to 70,000 sec.-ft.

Concrete quality control

The City of Seattle has long maintained a concrete testing laboratory in which problems with reference to quality of concrete have been analyzed and studied from many different angles. The man who has supervised this work for the city for 35 years, H. F. Faulkner, was sent to Ross Dam when work on the first step started. He is now at Ross Dam again, this time as resident engineer on the second step. Under his supervision the most careful attention has been given to selecting aggregate and to making the proper concrete combinations. The result of this unusually thorough attention is apparent in the quality of the concrete produced.

Before deciding on proportions for the concrete mix in step 2, tests were made on the concrete placed in step 1, using information thus derived as a guide in the later work. Some two dozen 6-in. cores were cut for this purpose from concrete that had been in place in the first step for three years.

Compression tests on these cylinders showed strengths on Class A concrete made with 1 bbl. of cement per cu. yd., ranging from about 5,000 psi to a maximum of 10,740 psi. On the Class B concrete, made with 1.3 bbl. of cement per cu. yd., the strength range was from a little below 6,000 lb. to 11,500 psi.

These cylinders were taken from different sections of the dam. In the best three groups, including both Class A and Class B concrete, minimum strengths exceeded 8,000 psi. and the averages were 9,130, 9,740 and 10,330 psi., respectively.

In the Class A concrete the average water-cement ratio was 0.56 and the slump was 2 in. In Class B. concrete the average water-cement ratio was 0.51 and the average slump 2½ in. In both grades the aggregate was made up of cobbles (passing 6-in. screen, retained on 3-in screen)

TABLE I—COMPARATIVE DATA ON SUCCESSIVE STAGES OF ROSS DAM CONSTRUCTION

Stage	Dam Height (Found. to Crest) (ft.)	Crest Height (Above Sea Level) (Roadway) (ft.)	Reservoir Storage (acre-ft.)	Dates (Actual or Proposed) Start	Complete	Concrete Yardage This Stage (cu. yd.)	Cost This Stage (Approx. in dollars)	Base Thickness (ft.)
1st step	290	1,365	70,000	8/13/37	3/30/40	327,000	7,000,000	200
2nd step	475	1,550	676,000	2/10/43	12/31/45	440,000	12,500,000*	200
3rd step	575	1,650	1,800,000	1949	1951	160,000	3,000,000	200
4th and ultimate step	675	1,750	3,150,000	(Cannot be determined at this time)				

* Includes parts of two power tunnels 27.5 ft. in diameter.

TABLE II—STATISTICAL DATA ON SKAGIT PROJECT AND ROSS DAM

Skagit Project	
Skagit River stream flow (max.)	115,000 sec.-ft.
Skagit River stream flow (min.)	470 sec.-ft.
Ultimate development (on basis of 40% load factor):	
Gorge plant, 320,000 hp. at 385-ft. gross head	
Diablo plant, 320,000 hp. at 330-ft. gross head	
Ross plant, 480,000 hp. at 520-ft. gross head	
Drainage area tributary to Gorge plant	1,200 sq.mi.
Average annual rainfall	74 in.
Ross Dam	
Elevation of lowest concrete	1,075 ft.
Length of Ross Lake, El. 1,535	21 mi.
Length of Ross Lake, El. 1,635	27 mi.
Spillway capacity (no gates), El. 1,535	127,000 sec.-ft.
Spillway capacity twelve 18x20' gates, El. 1,635	127,000 sec.-ft.
Additional power secured annually by second step without more generating units	300,000,000 kw.-hr

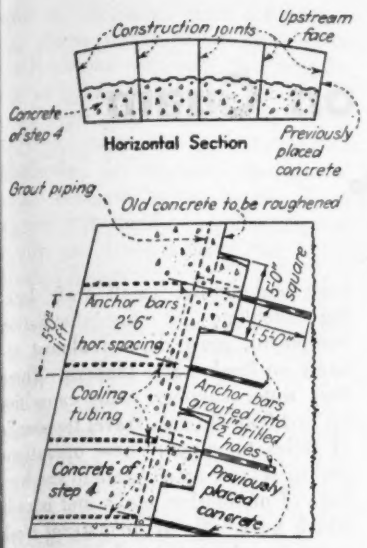


Fig. 5. *Details of joint on downstream face designed to bond fourth-step concrete with that of the three preceding.*

coarse gravel (passing 3-in screen, retained on 1½-in. screen), medium gravel (passing 1½-in. screen, retained on ¾-in. screen), pea gravel (passing ¾-in. screen, retained on $\frac{3}{16}$-in. screen) and a good quality sharp sand.

In examining these strength figures it is to be noted that the cores were cut from the mass concrete in place. In other words, the 6-in. cobbles were in the concrete tested, as they would not have been in test cylinders filled with the concrete mix at the time of pouring. Assuming that cobbles are stronger than the mortar, the strength of the sample is increased by the presence of cobbles because they increase the ratio of cement content in the mortar for a fixed quantity of cement per cubic yard.

On this point an engineering board reporting to the U. S. Bureau of Reclamation, referring to 6-in. diameter concrete test cores taken from Grand Coulee dam, points out that "the strength of cast test cylinders would be roughly 50 percent greater than that of the cored cylinders."

Cooling and grouting systems

In designing the second step provision was made for circulating cooling water through the freshly poured concrete. The natural temperature of the river water is such that it was not considered necessary to cool it artificially. The usual arrangement and spacing of cooling tubes was provided for and a minimum velocity of the circulating water was set at 2 ft. per sec. Catwalks, ladders and platforms installed for easy access to and inspection of the cooling system are left in place for use in grouting operations.

Because of uncertainties in estimating the cost of carrying on the cooling operations, the contract provides for paying for the cooling operations in three ways: (1) A lump sum price bid by the contractors for furnishing and installing the necessary pumps and pipes or tubes for circulation: (2) a unit price to be multiplied by the number of kilowatt-hours of electrical energy actually used for the pumping; and (3) a price per pound for placing the cooling water pipes embedded.

The grouting program provided for forcing neat cement and water into all contraction joints. The use of cool water in the grout mixture was specified to prevent the grout from setting too quickly. Water above 70 deg. F. was prohibited. The joints are grouted in sections consisting of 50-ft. lifts, the provision being that each successive 50-ft. lift must be completed before beginning the work next above.

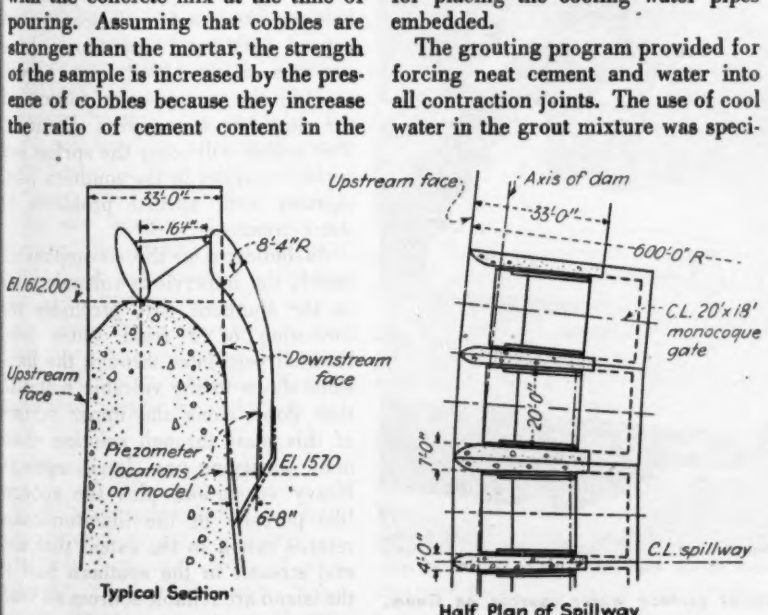


Fig. 6. *Type of deflector tested for use on third step on Ross Dam.*

Fig. 7. *Mucking machine working in one of the two 24½-ft. penstock tunnels.*

The second step in the raising of Ross Dam is being carried out by contract for the city of Seattle, Department of Lighting, of which E. R. Hoffman is superintendent; W. C. Snow is assistant superintendent; W. B. Wolfendale is project engineer for Ross Dam; H. F. Faulkner is resident engineer and concrete technician at Ross Dam; and C. E. Shevling is assistant resident engineer.

On the work now under way the general contract is held by a combination of three firms: The General Construction Co., J. F. Shea Co., Inc. and Morrison-Knudsen Co., Inc. In charge for the contractor on the job are Thomas H. Orme, project manager; C. W. Wood, general superintendent, Forest Jones, assistant superintendent and R. W. Jones, project engineer.

The contract was awarded on Feb. 10, 1943 for $7,144,922.64 with the construction period scheduled for 18 months. Since the time of the award of the contract, additional items including power tunnels, access tunnels, excavation for spillway approach, etc. have raised the contract price to about $11,000,000. Consultants retained by Seattle for this step were John L. Savage and B. E. Torpen, consulting engineers; Prof. Charles P. Berkey, and Prof. Howard A. Coombs, consulting geologists.

Surface Water Supplies on Guam

Lieut. (j.g.) Glen H. Abplanalp

(Civil Engineer Corps, U. S. Naval Reserve)

Editor's Note: *Augmenting the underground water supply at Guam, which was described in the issue of Sept. 6, vol. p. 316, are the springs and surface supplies that have been developed to service the Navy's floating forces. Lieut. Abplanalp, who has been in charge of much of Guam's water treatment facilities, tells of the processing facilities and the chlorination techniques employed to assure high-quality water.*

As THE NAVY moved ever forward in the vast Pacific war, the water resources of Guam played a large part in supporting both the forces afloat and the assault troops. Not all ships of the Navy are completely self-sufficient so far as fresh water is concerned. The large ships, composing the main line of naval forces are; but the huge array of landing craft and similar small craft, lacking adequate or any distillation equipment, must depend almost entirely on fresh water tankers. These fleet water carriers, with capacities up to 4,000,000 gal., travel thousands of miles to support new operations and to service small craft in the harbors of numberless atolls and islands which have little or no natural fresh water supply.

Apra Harbor, the huge Seabee-built fleet haven of Guam, is located in the southern portion of the island where there is little or no groundwater. Hence, water for forces afloat has been developed from the ample surface and spring supplies which flow over nearby parts of the island.

U. S. Navy Official Photos by John Mason, Ph. M. 1-c.

Fig. 1. Bona Spring, one of several similar surface water sources on Guam, bubbles out from under a pervious limestone cap on top of an impervious volcanic rock. The water is collected in a concrete catchbasin.

Geology and water supply

The island of Guam is of volcanic origin. The northern half, largely composed of coral limestone overlying the igneous rock, contains a large lens of fresh water floating on the denser saltwater, while the southern half consists of a dense volcanic mass capped with coral limestone. In a previous article (*ENR* Sept. 6, vol. p. 316) the groundwater sources in the northern sector were discussed. This article will cover the spring and surface supplies in the southern part, together with special problems in water treatment.

As indicated in the accompanying sketch, the impervious volcanic mass in the southern part precludes the formation of a fresh water lens. Rainfall percolates through the limestone down to the volcanic material, then flows along the upper surface of this mass through solution channels, emerging as large springs. Heavy vegetation, plus the sponge-like porosity of the limestone cap, retards runoff to the extent that several streams in the southern half of the island are reliable sources all year.

Water development in this area is from two main sources, springs and

streams. Although there are numerous places where water flows from the limestone cap, only two supplies are of considerable size, Dubo and Bona Springs. Water from Dubo Springs, high up on Alamagosa Mountain, is captured in several small concrete catch basins, from whence it is piped to a collecting reservoir, and from there to the 1 mg. Maanot Reservoir.

During the rainy season these springs produce more than 2 mgd. However, during the dry season a steady decrease from 35,000 to 50,000 gpd. has been observed. Normal output during the dry season runs from 1.0 to 1.3 mgd. The supply responds readily to rainfall, the output increasing from 0.5 to 1.0 mgd. in 24 hr. after heavy rains. As would be expected, the springs become turbid following excessive rainfall.

It is interesting to note that the only evidence on the island of water system sabotage from the few Japs still at large was discovered at Dubo Springs. A heavy decrease in output led a patrol to examine the pipeline, and finding no breaks, it went all the way to the springs in the hillside jungles. There it was discovered that the Japs had jammed a short 8-in. log into the effluent pipe leading from the largest spring.

Due to the extreme variation in flow at Dubo Springs, it was necessary to collect Bona Springs in a concrete catchment and pump this water into the Alamagosa system. This supply is generally good for 350,000 to 500,000 gpd.

Agana Springs, located 10 ft. above sea level in a natural sump at the base of a huge coral limestone formation, remains a reliable supply during dry weather as a result of the mass of the aquifier supplying this spring. The only change noted has been a gradual reduction in spring level. Only slight increases in turbidity have been observed following periods of heavy rainfall. Normal production ranges from 1.25 to 1.5 mgd.

Stream water developments

While many streams are currently being filtered as potable water supplies, only three are worthy of mention—the Pago, Ylig and Zaduc (Maagas rivers.

The Pago River plant, designed to produce 0.6 mgd., consists of low-lift pumps discharging the water into an over-under baffle-type flocculator, from which it flows into six 10,000-gal. steel settling tanks fitted with inlet baffles and outlet weirs. From the outlet weirs the settled water flows to an aerator, from which it is picked up by marine trailer-mounted filter units and filtered into clearwell tanks. High-lift centrifugal pumps, connected in series deliver the finished water to storage.

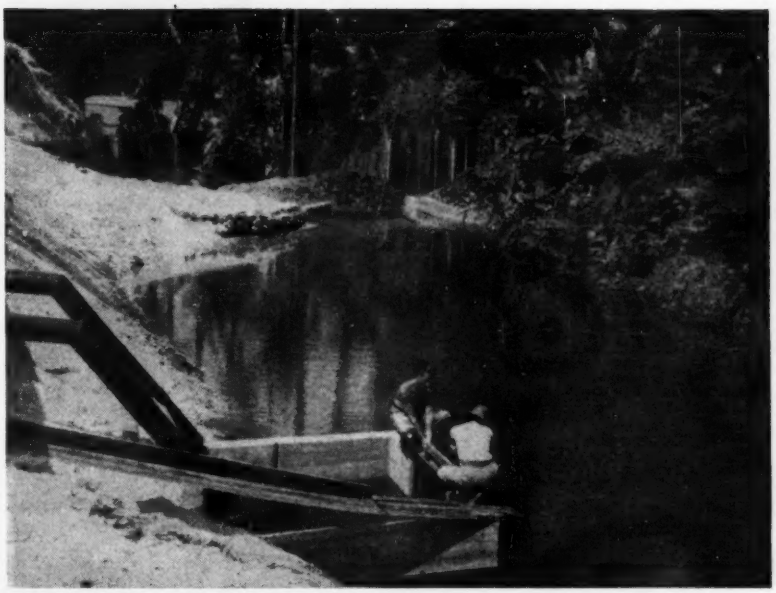


Fig. 2. A second source of surface water supply on Guam is the streams, of which Zaduc Maagas, shown here, is one of the largest. A small diversion dam of sheetpiling maintains the water level in a concrete pump sump.

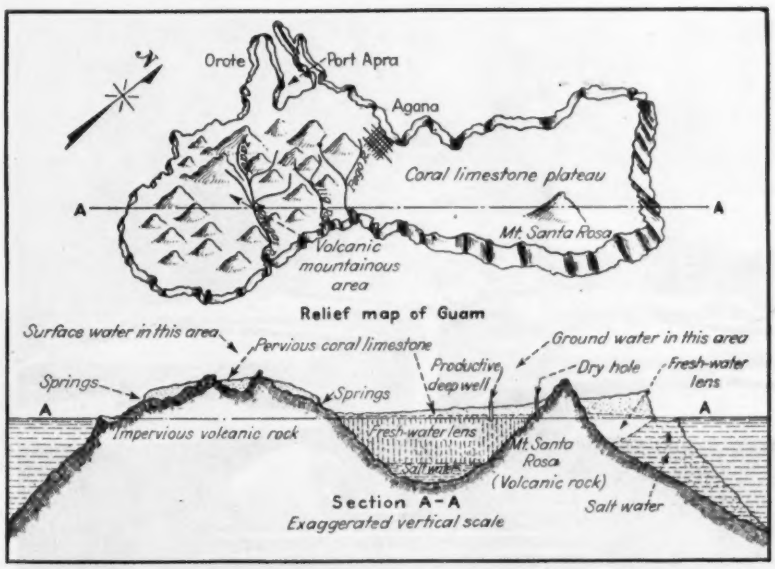


Fig. 3. Diagrammatic sketch of the geology of Guam, showing the distribution of the groundwater and surface water sources.

Alum is applied at the suction of the low-lift pumps. Reasonable dosage control is maintained by using lump ammonium alum applied in oil drums. A small filtered water line under pressure enters the drum under a false wood bottom, and the alum solution flows from the top of the drum through a small weir box. The amount of alum is controlled by a ½-in. globe valve in the small filtered-water line.

Prechlorination dosage by a panel-

Fig. 4. Portable trailer-type water filters as used by advance-echelon troops. These units are manifold connected for temporary treatment at a large surface water station on Pago River; they have a capacity of 0.6 mgd.

Fig. 5. The Pago River plant now includes this wood tank flocculator and six steel settling tanks.

mounted direct-feed chlorinator in the discharge of the low-lift pumps is followed by post-chlorination in the filter units.

Because these filters are combat equipment, they are being replaced with six 2-gpm.-per sq. ft. rapid-sand filters, which are being improvised from material available to the Seabees. The filter shells are 5,000-gal. wood-stave tanks. Filter gravel is obtained locally, but filter sand is taken from combat treatment units and utilized for the filter medium. No rate controllers were available, so orifice plates were placed in the filter discharge in order that filtered-water rates and head loss through the filters can be determined directly. Filtering rates are adjusted periodically by the manual operation of a gate valve in the filtered-water effluent line.

In developing the Ylig River supply, three 80-gpm. semi-permanent water treatment units were installed. Each of these units consists of low lift pumps with hypo-chlorinators for prechlorination, alum and soda ash application. Discharge from the low-lift pumps is carried to a combination settling tank and a baffle-type flocculator. Settled water flows by gravity to two rapid-sand filters from which the filter effluent is picked up by high-lift pumps chlorinated with an automatic hypo-chlorination unit, and delivered to two 126,000-gal. clear-well tanks.

High-lift pumps in service

From the clear wells other high-lift pumps deliver the water through some 10,000 ft. of pipeline to two more 126,000-gal. tanks. From these storage units it flows by gravity to the several battalion camp areas. This plant can produce between 320,000 and 345,000 gpd.

As the demands of land-based forces and forces of the fleet have continued to increase beyond the capacity of Dubo and Bona Springs, the Zaduc Maagas River was developed as an emergency supply to augment the spring supplies.

Some 14,000 ft. of 12-in. flexible-coupled pipe were laid from the stream to Maanot Reservoir, and three high-lift pumping stations were constructed, all by one Seabee battalion in 35 days. Plans have been prepared and materials requisitioned for a 2-mgd. filter plant at

the permanent development of this supply. The stream is entirely reliable except that following heavy storms excessive turbidity makes it necessary to cease pumping for periods ranging from a few hours to a day.

Treatment by chlorination

Because chlorination is the easiest means of sterilizing large quantities of water to a potable condition, all water for human use is so treated at Guam.

In the early days of operation about 90 percent of the water was hauled in trailers, jerry cans, oil drums and steel pontoon cells. Today perhaps 20 percent is hauled to campsites, the remainder is piped. Several large water points were established in the early days to serve the motley fleet of water haulers. Due to the oft-times questionable cleanliness of the containers and constant danger of after-pollution, a minimum chlorine residual of 2.0 ppm. has been maintained at all water points.

Before the arrival of gas chlorination equipment, home-made barrel-type units were used with good results in treating the Alamagosa and some smaller systems. All native village supplies are still being treated in this manner. With the arrival of automatic solution-feed vacuum chlorinators, together with solution-feed chlorinators, all major supplies were converted to gas-fed equipment.

Of particular interest from a chlorination standpoint is the Alamagosa system. The springwater influent to the 1-mg. reservoir is chlorinated with a dosage of 4.0 ppm. The residual drops, mainly due to sunlight, to a trace at the effluent where an automatic vacuum chlorinator maintains slightly more than 2.0 ppm. The 4-mi. service main from the reservoir supplies land installations throughout its entire length. A 4-mg. steel tank for fleet storage is located at the end of the service main, from which water is dispensed to fleet tankers through a submarine supply line.

In order to maintain a minimum of 2.0 ppm. residual in the water being loaded aboard fleet tankers, a solution-feed gas chlorinator was installed on the effluent on the tanks. Because of the desirability of maintaining a residual from the reservoir to the storage tanks, it was decided to operate well above the break-point, as experience has shown that chlorine residuals in this range will endure for longer time and effectively sterilize the water treated. The "flash residuals" of 2.0 ppm., characteristic of residuals beyond the break-point, were observed with a total dosage of 6.0 ppm.

This high-chlorination practice was continued with the following results: After one month a residual of 1.5 to 1.75 ppm. was available at the tank storage, a distance of over 4 mi. from the point of application. It should be noted that the drop in residual amounted to only 0.25 or 0.5 ppm. Tests made on water in the completely covered fleet storage tanks, which had been there more than three days, still showed 0.5 to 0.75 ppm. residual.

When the mains are opened for repairs, the inside of the pipe always appears as an absolutely clean metal surface, with no evidence of taste and odor-producing growths that normally cover the inside of under-

Fig. 6. As part of the Pago River treatment plant the Seabees designed and built this aerator for carbon dioxide removal and taste control.

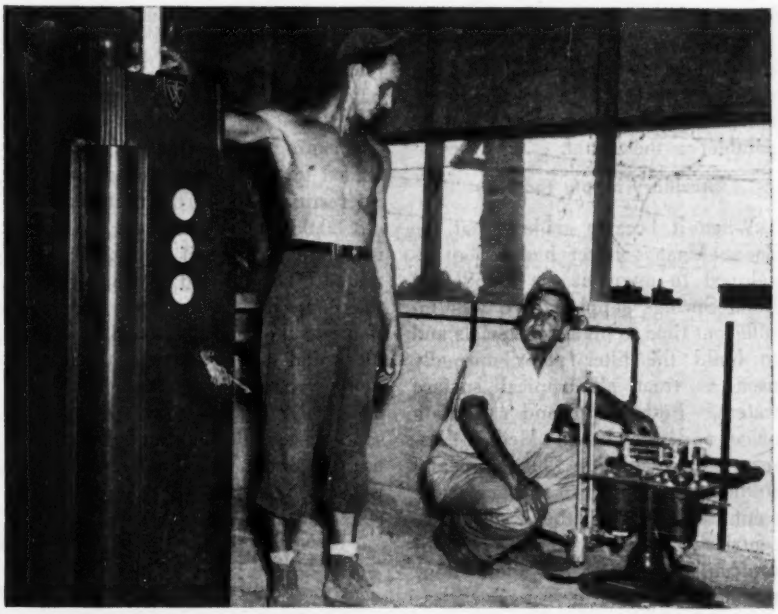


Fig. 7. Lt. (jg) Glen Abplanalp, (right) adjusts the chlorine gas rate on a gas-type chlorinator treating the effluent from the Maanot Reservoir. This supply serves Guam's busy Orote Peninsula and Apra Harbor.

Fig. 8. At the Ylig River plant the treatment equipment includes three semi-permanent purification units, each consisting of a flocculator, settling tank, two rapid-sand filters and high and low-lift pumps. Plant capacity is 350,000 gpd.

chlorinated mains. No taste has been noticed with the high dosages used, and the water is classed as the most potable on the island.

Auxiliary supply facilities

When it became evident that the Zaduc Maagas River had to be developed to augment the Dubo and Bona Springs supply, there was insufficient time to obtain materials and to build the filter plant normally used to treat all tropical surface waters. Both the island sanitation office and the Naval Medical Research Unit operating on the island studied the matter of proper treatment. Samples of the water were centrifuged for the presence of *Endoamoeba histolytica*, and none was indicated. The watershed was policed and found free of human habitation except for an occasional harrassed Jap fugitive.

To combat effectively all potential pollution hazards, it was decided that a minimum residual of 3.0 ppm. would be maintained from the first pumping station until the water entered the reservoir. Pumping rates were kept down to about 700 gpm. to provide a minimum contact period of 2 hr. before the water entered the reservoir. Chlorinators were installed in the first and third pumping stations to produce the required residual. Water flowing through 14,000 ft. of 12-in. pipe exposed to the tropical sun rises in temperature until it is definitely hot, yet in spite of the high temperature, residual requirements have been met with dosages of 6.0 ppm.

Cleaning one of the big tanks installed for fleet water storage was an interesting job. The unit was an old 80,000-bbl. riveted tank formerly used for crude oil storage in the States. The oil had so impregnated the plates that even after each section was thoroughly washed by hand, oil would still ooze from the plates upon riveting them into place. As a remedy, the tank was thoroughly sand-blasted, flushed, and then internally painted with a neat cement wash to minimize the possibility of taste developing in the stored water.

Sterilizing an oil tank

In order to conserve water and to reduce the time required for sterilizing the big tank, the following steps were taken: High-test hypochlorite, mixed into a slurry in steel drums, was applied to water being drawn into the tank so that 100 ppm. were present when the water was 2 ft. deep in the tank. No further water was added, and this strong sterilizing solution was then pumped over the interior tank walls.

This sterile flushing was continued for 1 hr. Then the tank was filled without removing the sterilizing solution, so the water in the full tank contained about 3.5 ppm. chlorine residuals. Results were so satisfactory that the same procedure has been followed in sterilizing other large tanks and reservoirs on the island.

Considerable difficulty has been experienced from large amounts of calcium bicarbonate in all the island water, particularly the ground water supply. Sodium hexameta phosphate is being used to good advantage in the Agana Springs system for combatting scale formations in heaters and hot water lines, with 3.0 ppm. being applied at the source. However, sufficient quantities of the chemical is not yet available for general use throughout the island. In some power plants acid has been added to the cooling water to eliminate scale in the diesel engine heat exchangers.

In one small area where water production is by distillation, an experiment was tried in the use of brackish water on the theory that the less salt in the water the easier it would be to distill. Brackish water was pumped from shallow wells about 450 ft. from the beach. The initial assumption, however, was far from correct, as the high carbonate scale formations made it necessary to remove the units from the line in less than 96 hr. It was clearly demonstrated that pure sea water produced the longest distillation runs with the least amount of trouble.

Looking back

In reviewing experiences in water treatment on Guam, one fact stands out: Reasonably high chlorine residuals can be carried directly to the consumer without undue taste com-

Fig. 9. Typical water point for issuing fresh water to tank trucks for transport to remote camp sites. The tanks are Seabee box pontoons, which have been employed for a wide variety of purposes on the war fronts.

plaints. It is believed that, due to the more nearly sterile conditions existing in mains carrying break-point residuals and the persistent nature of the residual, this practice will receive much wider recognition in post-war water developments.

A great tribute must be paid to the men who have, with outstanding attention to duty, operated the island water treatment plant through the past 12 months of hectic base development. Special credit is due Lt. Horace B. Gulden, the Seabee officer in charge of water development, in coordinating and directing the work that has been done. To "look at the record" and find that not a single case of sickness has been traced to the water in a year of operation is something of which all can be very proud.

Although great strides have been made in developing Guam's water resources, little would have been possible without the foresight of the Navy's Bureau of Yards and Docks in providing the special prefabricated filter plants, pumps and other special units so necessary where time is the vital factor.

Court Upholds Higher Water Rates For Users Beyond City Limits

A court decision has validated the right of the city of Yakima, Wash., to charge higher rates for water it delivers outside its corporate limits than for water delivered to city residents.

The decision, handed down June 14 in the case of Nob Hill Water Co. *vs.* City of Yakima, held that the differential in rates must be based on financial and physical aspects of the water system operation. It also held that the city had a right to discontinue furnishing water outside the city limits.

The background of the case dates back to 1901 when the Nob Hill Water Co. was formed to receive water from the utility serving what is now a part of the city. The company was also to distribute water to persons living outside the city. In 1926 the city acquired the utility and has operated it ever since, supplying the Nob Hill system. During most of this service the city has maintained the same water rates for both its resident customers and those receiving water through the Nob Hill mains.

Early in the 1940's, however, the city established higher rates for non-residents. Representatives of the non-residents, together with the Nob Hill Water Co., filed a suit contesting the city's right to maintain the differential in water rates. A cross petition for a judicial declaration that it was no longer obligated to deliver water into the Nob Hill system was filed by the city.

On the basis of the evidence the court concluded that through property taxes the water customers inside the city limits had borne the financial burden of acquiring the system, that the customers receiving water through the Nob Hill system had borne none of this burden. They also concluded that the ill-repair of the Nob Hill system was wasting an abnormally great portion of the city water delivered into the system, and that the city was receiving no compensation for this wastage. In addition, the costs of billing and collecting water charges were higher for Nob Hill customers than for customers residing in the city.

On the basis of these conclusions the court held that the differential in water rates for residents and for non-residents receiving water through the Nob Hill system was justified. It also held that the city had "a right to discontinue the furnishing of water to the plaintiff and its patrons, upon the giving of reasonable notice of such intention."

British Construction Plant Record System

Harold W. Richardson
Western Editor, Engineering News-Record
(By Airmail from the Pacific Theater of Operations)

● Editor's Note:—At Okinawa in the last days of the war, the author met Wing Commander E. J. Fawdry, officer in charge of airfield construction for the British Royal Air Force. In discussing plans for a Lancaster bomber field to be built and operated by the British at Okinawa (cancelled by end of the war) he touched upon their system of construction plant records. While designed primarily for war construction, this system because of its simplicity and completeness, is applicable to peacetime construction operations. Major features are outlined in the following.

EFFICIENT USE of construction plant and equipment, depends upon proper care, maintenance and operation of the various machine units. This holds true in the rushed and confusing business of building for war the same as it holds for peacetime contract work—probably even more so, for in war operations efficiency tends to lag behind. But in war or peace, adequate equipment records must be kept or efficiency fades completely away.

The British recognized these facts when organizing the Airfield Construction Service of the Royal Air Force, a military unit somewhat similar to our Engineer Aviation Battalions. They, like we, were setting up a new engineering and construction organization whose personnel would not consist entirely of men experienced in the job ahead. Therefore they sensed, as we did also, the need for simple and complete instruction manuals and an equipment record system. The need was all the more apparent with the advent of lend-lease, by which different and strange (to them) items of equipment were made available to the British.

To make its construction operations as efficient as possible, the Airfield Construction Service prepared instruction manuals on both the methods of construction and the operating characteristics of the various equipment items. The two most important were a construction procedure manual on *Airport Construction with Heavy Equipment* and the *A.C.S. Plant Reference Book.*

The first manual considers airport construction by bulldozers, scrapers, rollers and rooters only, but covers the subject thoroughly from clearing to finishing the runway.

Subjects covered

Presentation is entirely by charts and sketches divided into two parts: (1) What has to be done to build an airfield, and (2) the functions and operating characteristics of each type of equipment. Correct and incorrect application of each are shown by sketches, and the various possible uses are indicated by charts showing the sequence of operations from clearing to finishing, the descriptions of operations to be performed, and the advantages and limitations of each type of machine. Working capacities, travel speeds and rates of production are also shown by charts. A typical airport job is described from start to finish, showing the proper application, use and results of the various equipment items.

The manual is so complete, yet so simple and clear, that any normally intelligent construction man could, by using it as a guide, do a good job of airport construction even if he had never built one before. It is in loose-leaf form to allow for additions and changes.

The second manual, the Plant Reference Book, is known as Vol. I of Airfield Construction Service Plant Publications. It, too, is loose-leaf in form, and is divided into 12 equipment classifications as follows: Earth moving, earth compaction, pumping, concreting, lifting (cranes), bituminous, quarrying and crushing, pneumatic and scarifying (compressors, rock drills, rooters), light railway, agriculture, well boring, and miscellaneous (such as generator plants and power saws). Each classification is broken down into equipment types.

The manual is principally a catalog of all equipment used by A.C.S. Each and every item is described by sketches and photographs. Descriptions of machines include a discussion of various attachments. The correct application is described for each class, as are also the proper functions and uses.

Detail descriptions of each item include sketches showing overall dimensions. Weights and methods of transportation are indicated, along with working capacities under various conditions and with different materials. Information as to model and appurtenances, such as engines and bulldozers, is given in full.

The manual is compiled largely from manufacturers' bulletins, supplemented by data from operating experience. A similar manual would be invaluable for the contractor.

There are two other volumes in this publication list. Vol. II, divided into two parts, contains (1) general

orders and modifications, and (2) servicing schedules. Vol. III is devoted entirely to spare parts.

Another important publication, applicable chiefly to military service, is the Scales of Equipment. It is a complete list of all tools, equipment and materials allocated to the various construction units in the field. The list includes items as far down as plasterers' trowels, tinsmith shears and blasting caps.

Still another useful booklet, subject to constant change is a table of labor constants and plant outputs for construction work. Overall efficiency of plant, and labor production in various types of work, rated in man-hours, make up the bulk of the tables.

Complete record system

The system by which is recorded the complete description and operating characteristics, the performance and hours of use, and the location and type of work done by each piece of equipment owned by A.C.S., comes under Part 1, Vol. II, known as General Orders and Modifications. This is also a loose-leaf manual, the first sheets of which are devoted to general orders and definitions, such as instructions as to moving plant over public highways, the delegated responsibility of various officers in charge of equipment, instructions as to under what conditions plant may be "cannibalized" or wrecked for its parts, procedure to be followed in loaning equipment, and an outline of the several records and reports to be prepared.

Most important and useful of all the record forms is the Plant Log Book. A separate log is maintained for each and every piece of equipment, kept in the plant files of the military unit to which the item is assigned.

Each log book contains all pertinent information pertaining to the equipment items, such as make, size, weight, model and serial numbers, date of acquisition, and attached or appurtenant plant, such as engines and bulldozers. Then, from regular reports submitted by the operators, service and repair units, the following data are kept up to date: Hours of work, servicing information, fuel and oil consumption, minor and major repairs, replacements and modifications. Remarks as to performance and any other pertinent information are also entered. Thus, the complete history of each unit is kept in one book.

Service and repair reports, compiled in the field, are also of value. For example, if persistent wear or breakage is indicated on a certain part of a group of machines, a modification order may be necessary. Such an order will call for strengthening or reinforcing the part in the field, perhaps only on new machines as received, or it may be made retroactive if of sufficient importance to protect units already in service. Sometimes the order will be directed solely to the manufacturer for changes in machines produced thereafter.

A plant inventory sheet shows all the major equipment items assigned to a military unit, and the serviceability of the machines. The list shows the number of items in use, the number on the deadline awaiting repair (1) by first echelon on the site; (2) by unit repair shops; and (3) that beyond the capacity of unit facilities. Incidentally, instructions read that "Commanding officers are to regard a percentage unserviceability figure of more than 5 percent as excessive."

Another form that has proved valuable is a personnel record of every equipment operator. This is part of his service record, and shows his relative skill as an operator, as rated by his various supervising officers. These records have enabled the officers to assign their best operators to the more important tasks, as well as serving as a warning against poor operators on certain kinds of equipment.

There are several other forms in the plant record system, but most of them apply to military operations only. The British officers admit the system takes some time and care, but they feel the increased efficiency and performance of the equipment obtained by use of the information supplied by the records more than pays for the trouble involved.

Marines Turn Bridge Builders

Engineer battalions of the U. S. Marine Corps, organized for amphibious operations, have become bridge builders on Okinawa Island, writes Major Robert S. Mayo, of the — Marine Division. The first 15 days of the invasion, he declares, "were a rat race, and we suffered from lack of transportation, especially in moving our bridging gear forward."

Major Mayo describes the first job of Bailey Bridge erection by the Marines as follows: Assault troops of the — Marine Division, in driving westward on the coast road of Motobu Peninsula, found that a 120-ft. span concrete arch bridge across a deep gorge had been partly destroyed by the retreating Nips. The troops, however, managed to get across the bridge, followed by a few jeeps, jeep ambulances and 1-ton trucks. While the Marine engineers were examining the bridge to determine the necessary repairs, the damaged structure suddenly collapsed, injuring nine men. Immediate action was imperative, for the assault troops were now cut off from reinforcements, supply and evacuation of their wounded.

This was an ideal spot for a Bailey bridge, but the Marines had no such equipment. Fortunately a 130-ft. Bailey span, belonging to a Seabee outfit, was located not far away, and it was borrowed and hauled to the site. It was a "double-single" type, complete with launching nose.

Peculiarities of the site made erection of the span difficult. The narrow approach road on the near side, carved from a rocky cliff, met the abutment on a curve too sharp to permit assembly of the full span in one piece. Therefore, the bridge was erected in sections, with the launching nose out in front and the back end weighted down by a bulldozer. Also, because of site conditions, the span was erected and cantilivered out into space at an angle to the final centerline. After being completely assembled, the bridge was pivoted about the near abutment and dropped into final position.

In spite of all difficulties the span was placed successfully and quickly as the Marines' first Bailey bridge job. Later the bridge was reinforced to carry 35-ton tanks.

Before enlisting in the Marine Corps, Major Mayo was a consultant and designer of compressed air tunnel and shaft equipment, associated with the Lancaster Iron Works, Lancaster, Pa.—H.W.R.

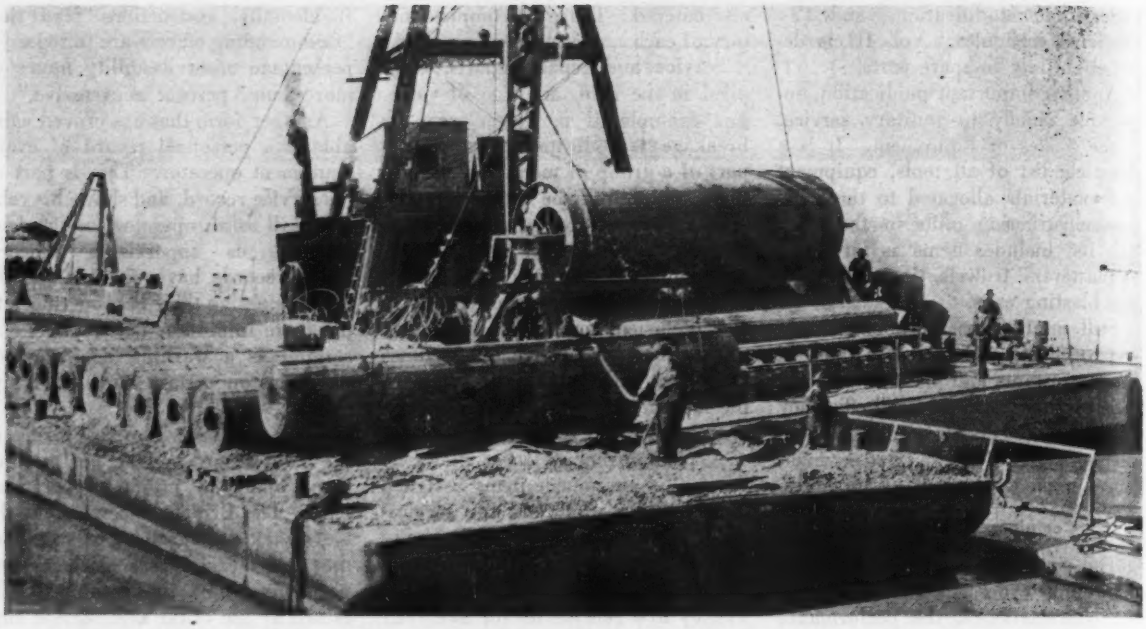


Fig. 1. Special equipment had to be developed to sink the new type concrete revetment installed along the Mississippi.

New Method of Revetting Old Man River

Lt. Col. A. B. Pickett
Military Assistant to the District Engineer
U. S. Army Engineers, New Orleans, La.

***Contents in Brief**—Revolutionary in design yet extremely practical in its methods of manufacture and installation is a new type of flexible reinforced concrete mattress developed recently by the U. S. Army Engineers for revetment along the Mississippi River. Initial installation at Miller Bend using mats 24 ft. wide, 60 ft. long and 1⅛ in. thick proves the method is a success.*

LATEST TYPE OF BANK protection for the Mississippi River is a reinforced concrete mat developed by the U. S. Army Engineers and designed sufficiently flexible to permit its being rolled onto a large timber core at the casting plant, transported by barge to the revetment site, rerolled onto a huge steel drum, and unrolled down the river bank under water to its final position. The mat is cast 1⅛ in. thick and in sections 24 ft. wide by 60 ft. long.

Bank protection or revetment on the Mississippi River has been an important item of flood control work for a number of years, but it has been assuming an increasingly larger role in this work ever since the passage of the Flood Control Authorization Bill last December (*ENR*, Dec. 28, 1944, vol. p. 806). Probably 80 percent of the $200,000,000 authorized in this bill for navigational improvement of the Mississippi between Cairo, Ill. and Baton Rouge, La., will be used for revetment work.

In preparation for this program, Brig. Gen. Max C. Tyler, president, Mississippi River Commission, Vicksburg, Miss., has been conducting model studies at the U. S. Waterways Experiment Station and has had his staff at Vicksburg, as well as the U. S. Army district engineers at New Orleans, Vicksburg and Memphis, working on plans for new types of revetment which can be installed by contract and to a large extent with standard construction equipment.

Although the limited installation to date of this rolled concrete mat does not permit an accurate appraisal of the extent to which it will replace the older 3-in. thick articulated concrete mat as installed last year at Goodrich Landing (*ENR*, Sept. 21, 1944, vol. p. 356), it does have certain inherent characteristics which may prove highly desirable in river bank revetment.

For instance, the *modus operandi* of its sinking has a distinct advantage over that employed for the articulated concrete mat in that the heavily-weighted steel drum, around which the mat is rolled for sinking, is less subjected to wave action and offsets to a marked degree any buoyancy, particularly in deep water, thus permitting the mat to be unrolled down the sloping bank underwater in its desired location. One of the bugaboos of sinking an articulated concrete mat in deep water has been the tendency for it to become semi-buoyant and to fold back onto itself. This

occasionally resulted in a faulty underwater installation.

The new mat also promises to be more resistant to erosion of river bank sand through it, than does the articulated mat, due to the smaller cracks provided in the concrete and to a 50 percent overlapping of each layer upon a previously placed section of mat.

This mat contains about 25 percent less concrete per square yard of laying area than does the articulated mat and a substantial amount of gravel insulation ordinarily required on the graded river bank is eliminated by installation of an upper-bank mat which prevents wave wash action. Whether these two factors will materially reduce the cost of installation is yet to be proved.

Old types of revetment

Some riprap has always been used in bank protection work, but its application is confined to pavement of the bank above the low water line. Protection of the underwater slope, which comprises about three-fourths of the total revetment, is accomplished by the installation of continuous, flexible mattresses of one type or another.

Early in the history of bank protection on the Lower Mississippi River, subaqueous mattresses of cane, brush, lumber and willow were developed. Of these earlier types, the framed willow and the willow fascine mattresses were employed most extensively. The growing scarcity of willows for revetment, however, led to the development of other equally durable types of revetment. Of three types of concrete mattresses developed prior to 1924 only the articulated concrete mattress is still in general use. It was developed originally in 1915 and, with subsequent improvements, is the most extensively applied revetment at this time.

Another type of revetment designed as a substitute for willows is the preformed asphaltic mattress, which was originated in 1932 from studies and experiments made in the New Orleans District to fit river conditions below Baton Rouge (*ENR* June 28, 1934, vol. p. 825). Launching operations for both the articulated concrete and asphaltic mattresses require specially designed plant not readily available to contractors.

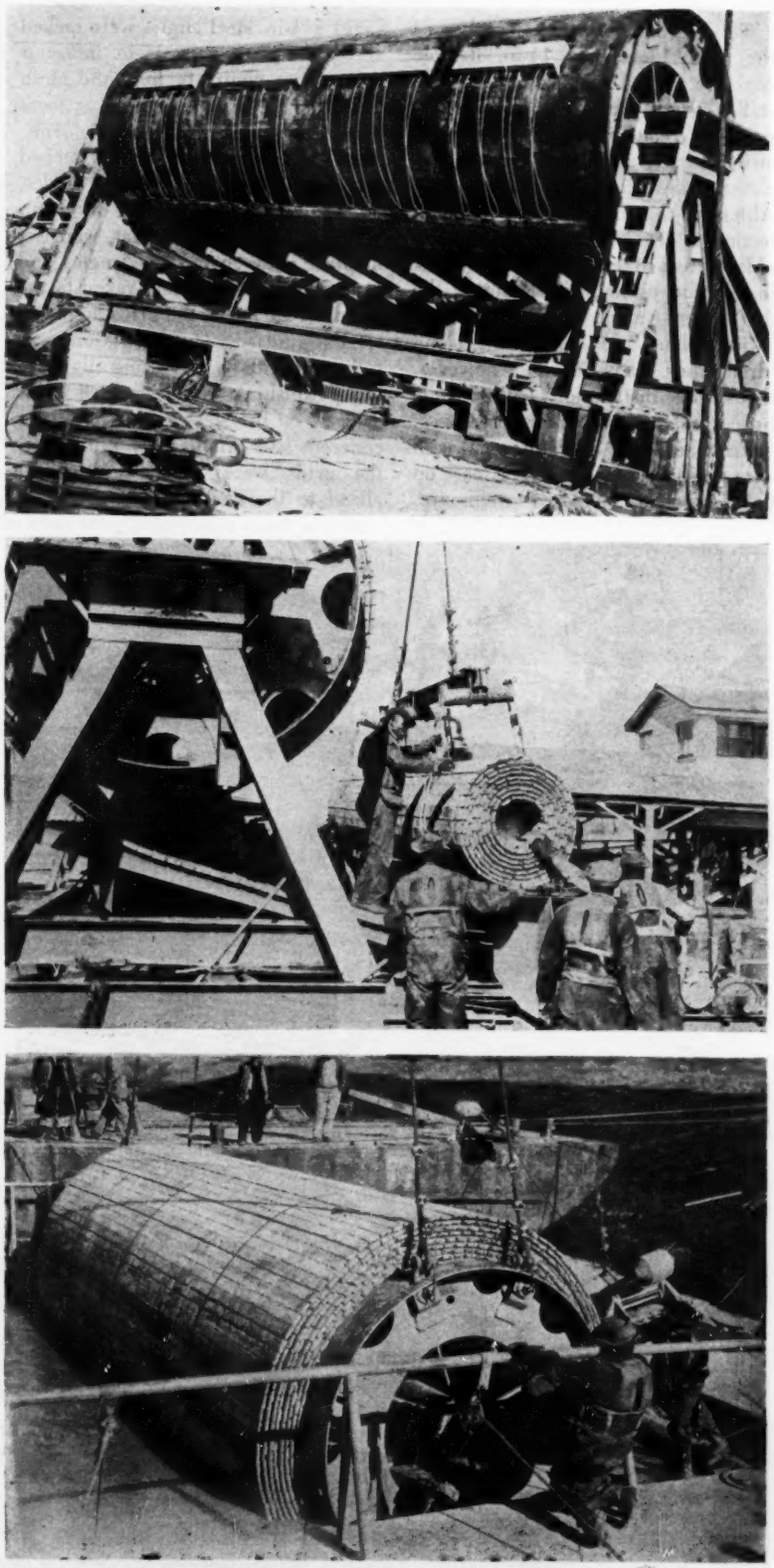


Fig. 2. Heavy concrete weights to anchor the outer end of the mats were set in recesses in the steel drum (top), four 60-ft. lengths of mat were rolled onto the drum (center) which then was lowered into a special launching cradle (bottom) preparatory to unrolling it down the river bank under water.

To determine the practicability of the newly developed 1½-in. flexible concrete mat, a test section was installed recently under adverse conditions of relatively high water and swift current at Miller Bend, about eleven miles above Greenville, Miss. Although this method of bank protection is deemed particularly adaptable to award by contract, the first installation as well as casting of the mat, were made by government owned plant and equipment, using hired labor. It is expected, however, that similar installations will be made by contract within the next year.

This new mat is reinforced with wire mesh fabric, and it was cast on flat forms of tempered wallboard. Light ½x½-in. steel angles were tacked across the platform at 16-in. intervals to serve as chairs to hold the mesh up from the forms, and as spacers for removable metal grid forms. The wire mesh was first stretched on the platform over the steel angles. Slotted metal grids, equal in depth to the thickness of the mat, were set in place between the steel angles and concrete was poured and raked to the required thickness, the grids acting as screed guides. The operation was followed with a vibrating light I-beam finishing screed, which rode directly on the steel grids. After the concrete had attained its initial set, the grids were lifted and moved ahead to the next platform. Curing was accomplished by spraying with a curing compound.

Removal of the steel grids left the concrete formed in slats 4 in. wide and 24 ft. long. The indentations left by the steel grids were V-shaped cuts, extending the full thickness of the mat, and measuring ½ in. wide at the top and ⅛ in. at the bottom. Adoption of this transverse V-shaped notch permitted rolling of the mat into a relatively small compact roll. Wire loop eyelets were cast in each end of the mat at 6-in. intervals.

After the mat had cured for two days, it was rolled up around a 17-in. dia. light wooden core to form a roll about 3 ft. in diameter and 24 ft. long. Rolls were strapped with ordinary steel packaging tape and set aside by a 1½-cu. yd. crawler crane. Each 24 ft. by 60-ft. rolled-up section (15 squares) weighed about 8½ tons.

Casting operations were conducted in the concrete casting yard of the Vicksburg District at Greenville, Miss. After being thoroughly cured the rolled-up mat sections were trucked to the river and loaded on barges as needed.

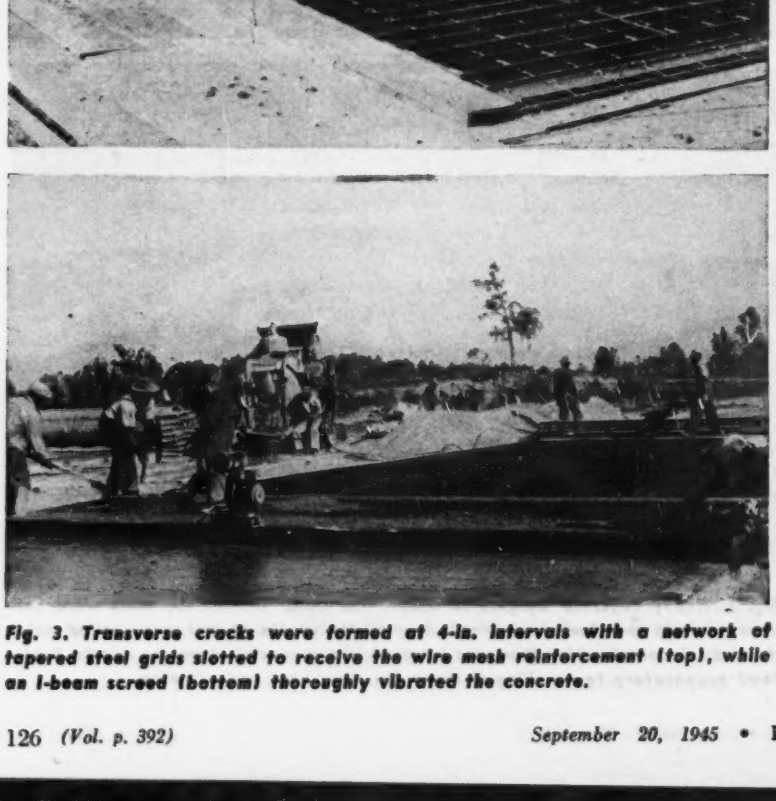


Fig. 3. Transverse cracks were formed at 4-in. intervals with a network of tapered steel grids slotted to receive the wire mesh reinforcement (top), while an I-beam screed (bottom) thoroughly vibrated the concrete.

Special launching equipment

Special launching equipment was developed to handle and install this new type of concrete revetment. A steel drum, 8 ft. in diameter, 26 ft. long with a 10-in. pipe axle, and a supporting structural steel frame with a truck engine and gear drive, together with a cradle made of spliced endless cables running around sheaves, was constructed in the shops of the New Orleans District.

A 60-ton floating derrick was rented and this steel drum equipment was mounted on the forward deck of the derrick. It is general practice, in mat laying operations, to use barges linked or lashed end-on-end for a stringout extending from the bank out into the river, to securely hold the plant for sinking the mats on range. Such a stringout was assembled of four barges for this test project. Four 8-ft. by 24-ft. steel pontoons were strapped and welded together to form a U-shaped floating platform with connections to attach it to the downstream side of the stringout barges a few feet from the shore.

The stringout barges, with pontoon platform, and derrick with rolling equipment mounted on deck, were

towed from New Orleans to Miller Bend. A rented tug towed the loaded barges of concrete rolled mat sections from Greenville to Miller Bend and tended the plant on the job.

The river bank was graded to a slope of one on four, from top of bank to about 10 ft. below water surface, following which the mats were laid under water and the sloped bank above water was paved.

First mat prevents wave wash

First operation following grading of the bank was to lay a covering to protect the slope from wave wash action at the water's edge. This was accomplished by setting 60-ft. long rolled-up mat sections on the bank about 25 ft. up the slope from the water, cutting the strapping bands and unrolling them down the slope. A curved hook, made of 2-in. pipe with a roller on the end of the hook, was placed over the roll and pulled from the derrick to insure the section unrolling under water all the way to its end.

The stringout of barges then was set on range with the derrick on the downstream side, facing the shore. The U-shaped floating pontoon platform was attached to the downstream side of the stringout directly in front of the derrick, between it and the shore, with the open part of the U towards the derrick to receive and properly align the roll of mat at the beginning of the laying operations. A supply barge of rolled-mat sections then was tied up to the downstream side of the derrick.

To hold the ends of the mat down securely in deep water after they were unrolled, four precast concrete anchor weights, weighing about 550 lb. each, were first set into recesses constructed in the face of the steel drum. The derrick then lifted a rolled-mat section from the supply barge and placed it in the cable cradle mounted directly in front of the drum. One end of the mat section was attached to the concrete anchor weights in the drum by means of looped strands embedded in the anchor weights. The drum was then revolved in the rolling frame until the 60-ft. long section of mat had been wound onto the drum. A second mat section then was set in the cable cradle and attached to the first section by threading a ½-in. wire strand cable through the eyelets that had been cast in the ends of the mat sections. This procedure continued until a mattress, the desired length in multiples of 60 ft., had been rolled onto the steel drum. At Miller Bend four sections of mats were joined together in this manner for a total laying length of 240 ft.

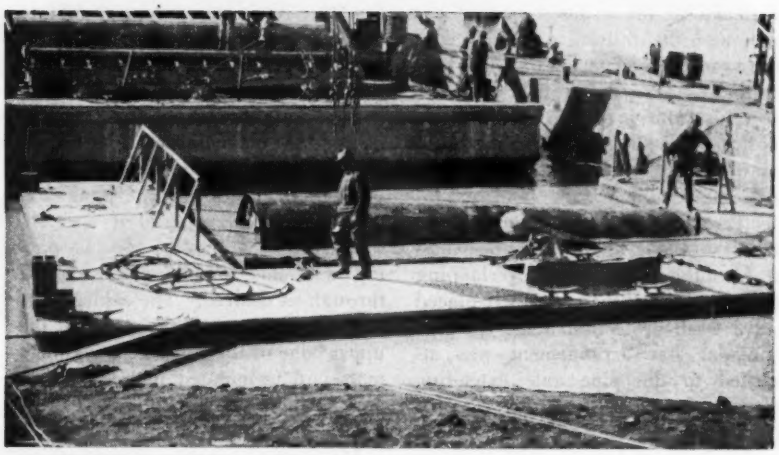


Fig. 4. Four steel pontoons were welded together to form a U-shaped floating assembly for sinking the mats. Note empty steel drum being rolled up out of the river after having sunk a roll of mats.

Fig. 5. Rolled sections of mat were lifted by a crawler crane and special sling, using a three-point pickup. Each roll weighed 8½ tons.

Some 4,000 squares (100 sq. ft. each) were used to revet 700 lin. ft. of river bank.

When the last section had been rolled onto the steel drum, a pair of concrete headers for attaching the anchor cables to the shore was

fastened to the exposed end of the mat and the roll then banded with the same type of packaging steel tape as that used to prevent the rolled-mat sections from unrolling during transport. Cable slings then were hooked onto the steel drum and it was lifted from the rolling frame and set directly over the head of the derrick into the water about 6 ft. deep, 24 ft. from the water's edge; overlapping the lower end of the previously placed wave wash protection mats. A pipe spreader bar arrangement was attached to the pipe axle extending from each end of the drum. A cable led from the river side of the roll out under the derrick to an outrigger arm located near the outstream end of the stringout of barges. A similar cable led from the shore side of the roll. Both of these cables were controlled by a winch on one of the stringout barges.

After the roll had been set on range by squaring with a transit set up on the bank, the shore end of the mat was anchored with cables to screw anchors set in the bank. The derrick was allowed to drift downstream from the stringout far enough to clear the path of the roll. The winch then started taking up on the cable to pull the roll down the slope into the river. It was prevented from rolling too fast by the hold-back cable leading shoreward from the spreader.

The roll was thus rolled down the slope past the end of the previously placed 60-ft. length of mat and continued until the end was reached, when the anchor weights fell out of the recesses in the drum. The winches then were reversed and the empty drum rolled back up the slope over the mat. The empty drum was picked up by the derrick and placed in the rolling frame for rolling up the next mat. The barge stringout was maneuvered by cables from winches in the usual way 12 ft. upstream and the next mat was laid, overlapping the previous one 50 percent of its width, thus providing a coverage of two thicknesses of 1½-in. flexible concrete mats laid shingle fashion upstream with the water flowing over the laps.

Following the laying of the rolled concrete mats to cover the underwater slopes was the job of protecting the graded bank above water. For this purpose, it was decided to place a hot asphaltic mixture of river sand and 5 to 6 percent of asphaltic cement. This was mixed at 325 to 350 deg. and placed with a clamshell bucket. The surface was raked down to an average thickness of 5½ in. No compaction, ironing or finishing was done as the chief purpose was to permit the water in the bank to bleed through the paving. The bank was seeping continually, and it was observed after laying the asphalt paving that the seepage was working through as desired. The asphalt was lapped down over the top of the upper edge of the concrete wave-wash mats and terminated in a key ditch just below the upper limits of the slope.

Mat-laying operations were carried on in December 1944 and January 1945 under very adverse river and weather conditions. While these conditions were not desirable, they served very usefully in demonstrating the circumstances under which the work could be carried on.

Development of the mat and methods of installation were conducted under the general direction of Col. George H. Hudson, district engineer, U. S. Army Engineers, New Orleans, La., and under direct charge of the author, assisted by Messrs. A. F. Jacobi, A. P. Woods, H. L. Brownlee and William Barth. Application has been made by the author for a patent on this flexible reinforced concrete mattress, with all rights reserved to the U. S. Government.

Mechanized Accounting Expedites Construction Job Cancellation

Some of the values of mechanized accounting methods that The Austin Co. has used in handling construction payrolls in connection with $400,000,000 worth of aircraft and chemical plants were driven home with dramatic impact recently. At 5:20 on a Friday afternoon, William Teeter, Austin project manager, received a telegram cancelling the contract for the half-finished $13,000,000 Defense Plant Corporation Army tire plant Austin was building at Tuscaloosa, Alabama, for The B. F. Goodrich Rubber Co.

By the time the shift ended 10 minutes later, word was already pretty well around the job that the government had called a halt on this and certain other Army tire plants. When the 1,600-odd construction workers filed past the time clock to punch out, they were told they could pick up their final pay checks in the morning.

With daily job records always up to date and ready for transfer to the automatic tabulating machines on the job before each next day starts, the time clerks went right to work on the last day's computation. They passed the cards along to tabulating punchers, who fed them into the calculating, recording and check writing machines just about as rapidly as the time clerks could keep them coming. By morning the checks, with all computations for overtime, social security and income tax deductions made and clearly indicated on their face, were ready and waiting for the men.

Complete payroll records, in their final form, with full distribution and segregation of payroll expense, and the breakdown covering all construction labor overhead such as workmen's compensation and public liability insurance, was in the hands of all interested parties before noon. The Defense Plant Corporation, Goodrich and Austin all knew just where they stood.

At the same time, complete old-age pension, unemployment insurance and income tax payroll deduction records required by various government agencies and bureaus, were automatically available, without any special push at the wind-up. With these details out of the way, the clerical manpower released by speedy completion of the payroll accounting job was immediately available to work on the materials and equipment inventories and other work in connection with closing up the job.

Harold A. Hallstein, ranking Austin vice president, who was the company's general auditor for many years, credits mechanized payroll accounting with saving between 50 and 75 percent of the manpower normally required to handle large payrolls.

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4. Is non-corrosive to alloy bearings. Protects all lubricated engine parts against corrosion.

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For trucks, buses, tractors, shovels, stationary and marine Diesels.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

SEWER EXTENSION, WASH.

OWNER: City of Pasco, Wash.

PROJECT: Extending sewer lines in Pasco, Wash., involving approximately 17,000 linear feet of sewer pipe, necessary wye branch connections and manholes, paving cuts, trench excavation and backfill, and two sewer crossings under tracks.

CONDITIONS: Contractor to furnish all materials and complete work in 90 days. Rail and highway transportation facilities available. Wage rates are: skilled labor, $1.35 to $1.60 per hour; semi-skilled, $1.15 to $1.25; and common, 95c.

BIDS: Six bids were received April 17, 1945, ranging from the contract low of $41,286 to $73,715.

LIST OF BIDDERS:

1. Matt Malaspina & Co., Seattle, Wash. (contract) ... $41,286
2. V. F. Walters, Seattle, Wash. ... 44,691
3. Valley Constr. Co., Seattle, Wash. ... 51,682
4. Gallagher, Kirk & Thomas, Tacoma, Wash. ... 52,923
5. B. H. Sheldon, Spokane, Wash. ... 54,698
6. Goerig & Philp, Seattle, Wash. ... 73,715

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Paving cuts	500 s. y.	$5.40	$3.00	$2.00
2. Trench excavation, backfill	16,500 c. y.	.80	1.00	.80
3. Sewer pipe, 15-in.	1,960 l. f.	1.40	1.65	2.42
4. Sewer pipe, 12-in.	2,870 l. f.	1.07	1.15	1.83
5. Sewer pipe, 8-in.	12,450 l. f.	.73	.77	1.35
6. Wye branches, 15x8-in.	16 ea.	8.00	4.50	5.00
7. Wye branches, 12x8-in.	60 ea.	6.00	3.25	3.75
8. Wye branches, 8x6-in.	345 ea.	3.00	1.85	2.10
9. Manholes, up to 7-ft. deep	44 ea.	100.00	100.00	105.00
10. Drop manholes, to 7-ft.	5 ea.	130.00	135.00	120.00
11. Additional manhole depth over 7-ft.	150 ft.	10.00	10.00	9.00
12. Lampholes	6 ea.	35.00	40.00	30.00
13. Sewer crossing under tracks, A Street	Lump Sum	600.00	750.00	2,200.00
14. Sewer crossing under tracks, Hayes Street	Lump sum	1,800.00	2,100.00	4,000.00

HIGHWAY REPAIR, CALIFORNIA

OWNER: California Division of Highways, Sacramento, Calif.; G. T. McCoy, state highway engr.

PROJECT: Repairing 13.0 miles (portions only) of highway with untreated rock base and plant-mix surfacing between 1.7 miles east of San Luis Creek and Los Banos and between 1.7 miles north of Romero School and Los Banos in Merced County, Calif.

CONDITIONS: Contractor to furnish all materials except mineral aggregate which will be furnished by the State. Highway transportation facilities available. Time for completion is 125 days. Wage rates stipulated are: skilled labor, $1.50 per hour; semi-skilled, $1.00; and common, 90c.

BIDS: Seven bids were received May 16, 1945 ranging from the low of $179,847 to $239,153. The low bid was irregular, however, and the contract was awarded to the second low bidder at $180,748.

PARTIAL LIST OF BIDDERS:

1. Frank B. Marks & Sons and W. C. Railing, Redwood City, Calif. (irregular) ... $179,847
2. Louis Biasotti & Son, Stockton, Calif. (contract award) ... 180,748
3. N. M. Ball Sons, Berkeley, Calif ... 190,392

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Border trenching	13.03 mi.	$270.00	$225.00	$183.
2. Develop water supply and furnish watering equipment	Lump Sum	750.00	300.00	500.
3. Applying water	3,500 M gal.	1.50	1.50	1.
4. Imported borrow	4,200 c. y.	1.00	.85	
5. Untreated rock base	74,100 ton	1.34	1.28	1.
6. Liquid asphalt, MC-2	340 ton	23.00	22.00	20.
7. Sand cover	420 ton	2.50	4.50	2.
8. Handling mineral aggregate	22,200 ton	1.75	1.95	1.
9. Paving asphalt	1,000 ton	17.00	18.50	15.
10. Asphaltic emulsion (seal coat)	33 ton	30.00	36.00	28.
11. Screenings (seal coat)	250 ton	4.50	6.00	4.

HIGHWAY AND BRIDGES, TEXAS

OWNER: Texas State Highway Dept., Austin; W. H. Koether, Yoakum, Tex., engr.

PROJECT: Grading, drainage structures, flexible base and asphalt surface treatment of 3.057 miles of U. S. Highway No. 87 in DeWitt County, Tex. Includes construction of overpass spanning Texas & New Orleans Railroad, and erection of a bridge over Price's Creek.

CONDITIONS: Contractor to furnish all materials. Rail and highway transportation facilities available. Wage rates are to be those prevailing in area.

BIDS: Three bids were received August 21, 1945 ranging from the low of $241,150 to $317,111.

LIST OF BIDDERS:

1. D. R. Cloud, San Antonio, Tex. (low bidder) ... $241,1
2. Colglazier & Hoff, San Antonio, Tex. ... 291,5
3. Heldenfels Brothers, Rockport, Tex. ... 317,1

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	29.88 ac.	$100.00	$70.00	$80
2. Common road excavation	68,390 c. y.	.29	.40	
3. Rock road excavation	487 c. y.	1.50	1.50	1.
4. Common borrow	86,073 c. y.	.29	.40	
5. Common channel excavation	69,793 c. y.	.30	.30	
6. Unclass. struct. excav. (culv.)	351 c. y.	2.50	3.00	2.
7. Unclass. struct. excav. (bridges)	1,180 c. y.	4.00	3.00	8.
8. Stripping	3,800 c. y.	.25	.25	
9. Overhaul	153,332 y. qtr.	.05	.10	
10. Sprinkling	5,400 M gal.	1.15	1.90	1.
11. Rolling	245 hr.	4.00	4.00	5.
12. Rolling	978 hr.	4.00	5.00	4.
13. Rolling	464 hr.	4.00	5.00	4.
14. Flexible base	19,605 c. y.	1.00	1.44	2.
15. Blading	23 hr.	5.00	5.00	7.
16. Prime coat (MC-1)	10,123 gal.	.10	.11	
17. Asphalt (OA-230)	23,500 gal.	.10	.10	
18. Aggregate	753 c. y.	3.50	4.25	1
19. Class A conc., culverts	395.78 c. y.	28.00	28.00	27.
20. Class A conc., abutments and bents	456.73 c. y.	30.00	30.00	30.
21. Class A conc., girders and slabs	844.38 c. y.	27.50	30.00	30.
22. Class A conc., floating slabs	37.28 c. y.	23.00	24.00	32.
23. Class A conc. for extending struct.	193.84 c. y.	28.00	34.00	32.
24. Class D concrete	276 c. y.	15.00	16.00	20.
25. Reinforcing steel	363,517 lb.	.09	.06	
26. Reinforcing fabric	4,700 lb.	.09	.10	
27. Structural steel	99,774 lb.	.09	.08	
28. Railing (Price's Creek Bridge)	560 l. f.	2.00	4.00	4.
29. Blast plates	7,950 lb.	.15	.14	
30. 24-in. extr. str. rein. conc. pipe	42 l. f.	4.11	3.60	2.
31. 30-in. extr. str. rein. conc. pipe	193 l. f.	5.25	4.60	4.
32. Remove old structures (small)	9 ea.	75.00	50.00	10
33. Remove old structures (large)	2 ea.	800.00	2,200.00	2,00
34. 16-in. oct. precast conc. test piling	135 l. f.	7.30	7.00	1.
35. 16-in. oct. precast conc. piling	2,091 l. f.	5.00	4.50	4.
36. Railing (overpass)	530 l. f.	2.50	4.00	4.
37. Concrete riprap	285 c. y.	15.00	16.00	2.
38. Cement mortar riprap	87 c. y.	8.50	10.00	15.
39. Block sodding	4,640 s. y.	.40	.50	
40. Grass retards	143 c. y.	2.35	2.00	4.
41. Mulch sodding	2,500 c. y.	1.50	2.00	2.
42. Rock retards	216 s. y.	2.00	.50	
43. Conc. curb and gutters	320 l. f.	1.50	3.00	2.
44. Right-of-way markers	60 ea.	1.50	3.00	2.
45. Obliterate abandoned road	31.5 sta.	8.00	15.00	20.
46. Remove old concrete (pavmt.)	315 s. y.	40.00	2.00	40.
47. Remove guard fence	1,150 l. f.	.60	.25	1.
48. Remove, replace guard fence posts	168 ea.	1.00	2.00	1.

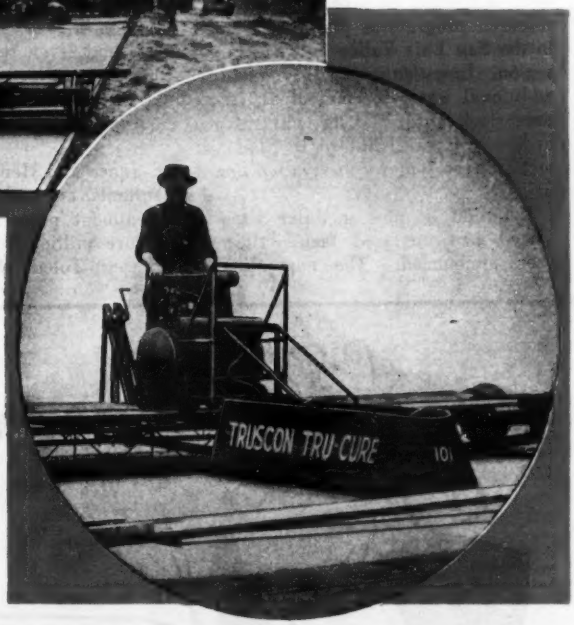
TRUSCON TRU-CURE for CURING CONCRETE

SPRAY IT ON

No paper — No burlap

Produces better concrete

One-Man operated Tru-Cure Multiple-Nozzle Applicator. (Patented)



Remove "BOTTLE NECK" FROM CONCRETE PAVING JOB

After the concrete has been finished—there is still the curing job. And curing has to be done right, especially at this time of year. Delays, which so often happen with old-fashioned curing methods—too much moisture is lost; and the concrete surfaces develop hair checks and crazing.

Because TRU-CURE is easily and quickly applied—because it is practical to use without danger of marring—because there is no waiting during this critical early curing period—Tru-Cure gets its protective, water-retaining coat on the concrete early.

With the one-man operated, multiple-nozzle Tru-Cure Applicator illustrated above, the curing job is no problem at all.

As proof of its curing efficiency and convenience, Tru-Cure was used on millions of square feet of concrete roads and airport runways.

Truscon Tru-Cure is a clear liquid—requires no removal, as the film wears off in a short time, after its curing function has been performed. Approved by United States Army Engineers and by numerous State Highway Departments.

Descriptive literature gladly sent on request.

TRUSCON LABORATORIES Inc. DETROIT MICHIGAN

TRU-CURE APPLICATOR

Above photographs illustrate a one-man, concrete road curing job, using the Tru-Cure multiple-nozzle Applicator pushed by hand across a bridge spanning the work. Each pass of the Tru-Cure Applicator cures a transverse six-foot strip of roadway (approximate). Then bridge is moved ahead by same man while standing on the bridge, using the handle ratchet device located at center. Note the wind shield protecting the spray arm.

Curing now is a very simple, efficient operation, requiring little equipment—a minimum of labor (one man easily keeps up with the paving crew and has time to spare) and protects the work from any possible deterioration from water loss due to neglect in wetting, loss of curing blanket from wind storm, and other causes.

Tru-Cure Applicator machines are available through equipment machinery manufacturers. Photographs and parts list may be obtained by communicating with any Truscon Laboratories' office.

BRIEF NEWS

Waco, Tex., has been advanced $7,254 by the Federal Works Agency for preliminary engineering work on a $200,000 project to enlarge the municipal sewage disposal plant, and $4,872 for preliminary engineering on a $136,000 storm sewer system. This preliminary work will be done by Joe Rady of Fort Worth.

To determine feasible methods for developing Colorado's underground water supply, the State Water Conservation Board is readying a survey in cooperation with the U. S. Geological Survey. Expected to take six years, the research program is planned to begin in the San Luis Valley and Big Sandy region. Investigations will be made for additional water for municipal, irrigation, stock water and agricultural production use, said Clifford H. Stone, director of the Water Conservation Board.

Adoption of new modular sizes of glazed and unglazed facing tile has been announced. The new sizes of facing tile will be 3¾ x 5 x 11¾ in. and 3¾ x 3¾ x 11¾ in., which will give nominal sizes of 4 x 5 1-3 x 12 in. and 4 x 4 x 12 in. when mortar joints are taken into consideration.

The Canadian government has ordered an engineering survey to decide whether a bridge or a causeway would be suitable to connect the shores of Canso Strait, thus joining the mainland of Nova Scotia with the island of Cape Breton. Government engineers will be assigned to prepare the data and report on the cost and advisability of the causeway or bridge. The connection would be used by a railway as well as for vehicular and pedestrian traffic, largely superseding the present ferry service.

Long Beach, Calif., took over its gas system in 1924. Since that time the city has had seven reductions in rates, and has turned over cash contributions to the city that are said to have averaged $400,000 per year for the last ten years.

Jones and Henry, Toledo, Ohio, consultants, are making a study of sewage treatment processes looking toward a future million-dollar expansion of the present Toledo disposal system.

The City Council of Dallas, Tex., has approved plans calling for an expenditure of $687,500 for the future enlargement of the Bachman water filtration plant, to produce 100,000,000 gallons per day. Included are a new chemical building and eight new filters. Myers & Noyes, engineers, will draw the plans.

The Brazos Conservation and Reclamation Board at Mineral Wells, Tex., has announced that plans are being made for three dams to be built in its district as part of its postwar flood control program. Basin-wide surveys of the Brazos River valley are being made by the United States Reclamation Service and Army Engineers. Dams being planned include a $4,000,000 one on the Brazos River at De Cordova Bend, a $6,000,000 project on the Lampasas River, and a $7,000,000 dam on the Leon River.

Reorganization of the Ohio Highway Department to prepare for major postwar road programs has been announced. Both administrative and engineering officers will be allowed to report directly to departmental heads, which is a new arrangement.

"WHAT GOES ON!" I BELLOWED,

"I might as well use a wooden spoon!"

We know how it is, Tom. Blurs and uneven lines and headaches. Use Typhonite Eldorado. How that pencil can draw! Crisp, sharp, dense lines — brilliant and true. No feathering or crumbling in the softer degrees; no grit in the harder degrees. Nice going!

And get this, Tom—Eldorado is dependably uniform in all degrees. A 2H is a 2H today, tomorrow and always! Eldorado is a sweet pencil. Try it! Send for a free Comparison Sample *now*. Request it on your business or professional stationery, specifying degree.

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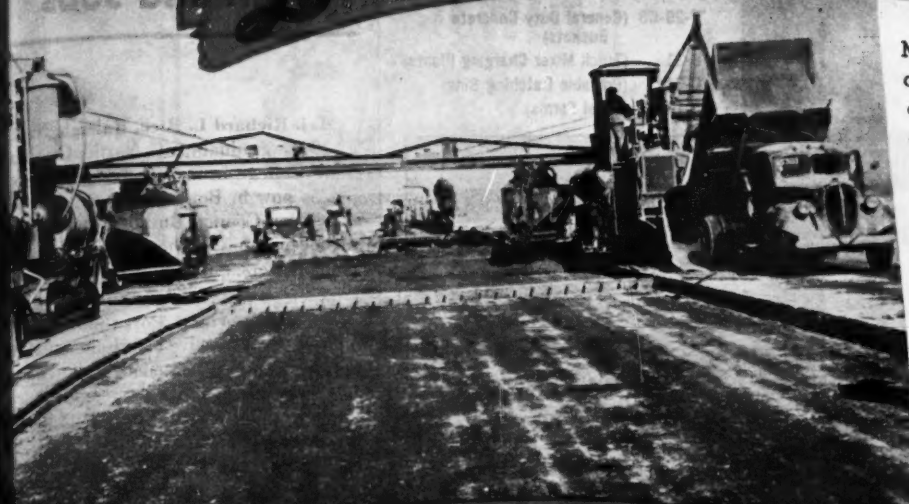
PENCIL SALES DEPT. 227-J9, JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY 3, N. J.

Lower Cost Concrete..



MultiFoote Pavers assure you of lower cost concrete because they get the cement and aggregate into the paver and out as thoroughly mixed concrete *faster.* Big, rugged skip has a full, wide mouth for faster charging from even the largest trucks. Double cone drum with its end-to-end scouring action mixes every batch in minimum time. Rotary discharge takes only a quarter turn to dump concrete into the big bucket. High operating platform provides greater visibility and faster, more accurate work. Write for details.

Lower Cost Black Top

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, it has still more power
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uphill or down. Expe-
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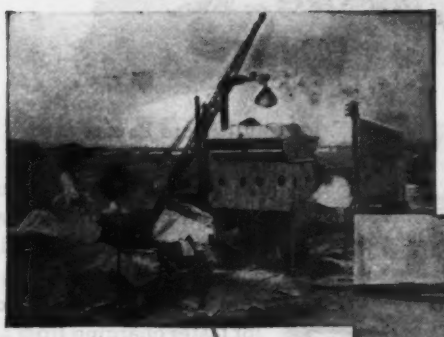
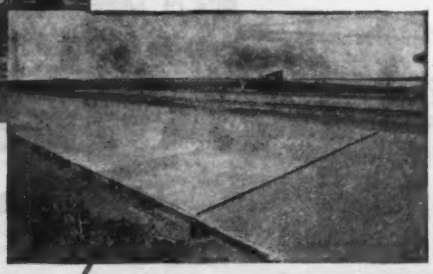
STEPS FORWARD
MULTIFOOTE CONCRETE PAVERS





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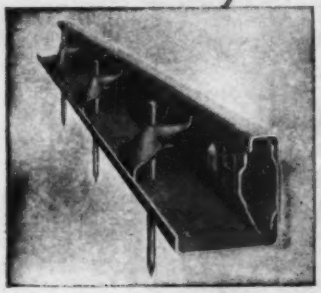
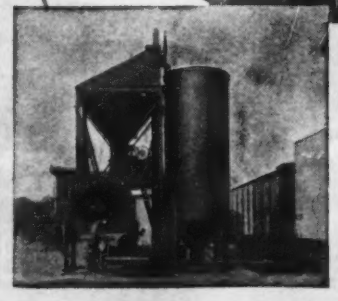
call Heltzel





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(Type of construction usually engaged in)

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FINISHING TOOLS FOR CONCRETE ROADS

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Men and Jobs

Maj. Richard L. Rice, Raleigh, N. C., a 1941 graduate of North Carolina State College in architectural engineering, is now in Berlin as an engineer on the Allied Council Building, quarters of the occupation authorities of the four main powers.

Reigel Fetterman, Port Clinton, Ohio, who recently received a discharge after serving as a first lieutenant in the Army, has been named project engineer for Ottawa County, with the State Highway Department.

Col. John W. Wheeler has returned to the Chicago, Burlington and Quincy Railroad as executive assistant after 4½ years service with the U. S. Army Engineers. Entering active service in January, 1941, as commanding officer of the 113th Engineering Regiment, Col. Wheeler directed the construction of the first airport at Hudson Bay, Canada, in 1942. Later he supervised construction of the Alcan Highway and at one time was assigned as an engineering consultant on the Ledo Road.

Col. Wheeler was appointed chief engineer of the 16th Corps on January 5, 1944, and served with the 9th Army in France, Belgium, Holland and Germany, taking an active part in the Ruhr River campaign, the crossing of the Rhine, and the subsequent occupation of the Ruhr industrial district.

Robert D. Mitchell has been relieved from active duty as major, Sn. C., and is now engaged by his former employer, Malcolm Pirnie, consulting engineer, New York City. In Mr. Mitchell's two year's service with the Army he served as assistant chief of the engineering section, division of health and sanitation, Office of Inter-American Affairs.

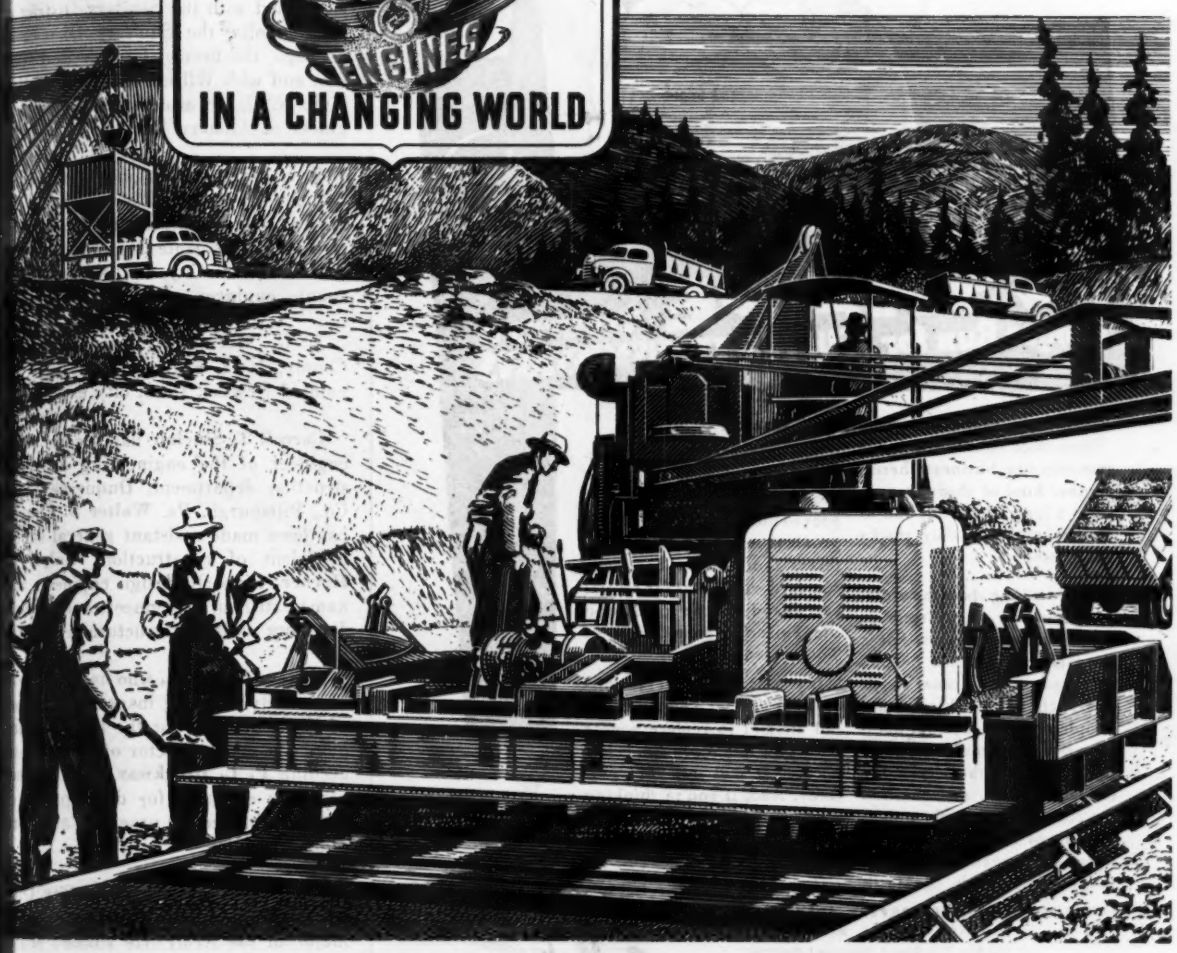
J. F. Byxbee, a graduate of Leland Stanford University, former city engineer and recently consulting engineer of Palo Alto, Calif., has terminated his work for the public works department. In Jan. 1941, he resigned as city engineer, after 35 years service and became consultant on a part-time basis. Mr. Byxbee was appointed full-time city engineer in 1906 after having served as part-time engineer since 1902.

Bernal H. Swab has joined the staff of Jones and Henry, consulting engineers, Toledo, Ohio. He recently completed a large flood control and drainage

POWER TO WIN

RED SEAL ENGINES

IN A CHANGING WORLD



CONTINENTAL . . . BUILDING THE HIGHWAYS OF PEACE

On the highways of peace, as well as on the highways to Victory, Continental Red Seal Engines are proving again and again their stamina and versatility. In the crane that loads the trucks — in the trucks themselves — and in the spreaders that lay the pavement there's Red Seal Power. Every Continental Red Seal engine has the added stamina, the dependable power created by the Continental team of advanced engineering and precision production.

Continental Motors Corporation

MUSKEGON, MICHIGAN

How SHAPE Assures a Longer Run for FULLER TRANSMISSIONS

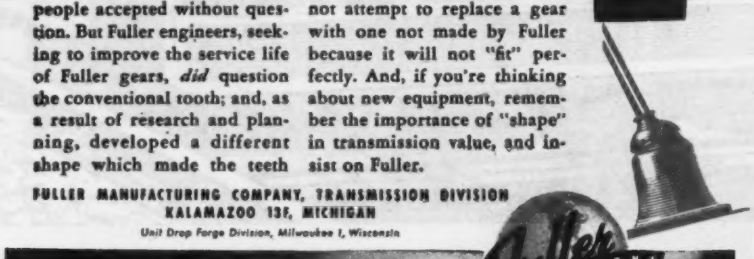
THE right shape can make box-office success, and in the transmission business there's another kind of shape that assures a long and steady run to owners of heavy duty trucks and busses.

We're talking about the cross-section shape of the teeth in the transmission gears. For a long time there has been a standard, conventional shape for such teeth which most people accepted without question. But Fuller engineers, seeking to improve the service life of Fuller gears, *did* question the conventional tooth; and, as a result of research and planning, developed a different shape which made the teeth much stronger

Thousands of Fuller Transmissions, in actual service of the most severe types, have proved the extra strength of the profile thus developed. The different tooth shape has been standard with Fuller for several years—and will be standard in the Fuller Transmission of Tomorrow.

If you have Fuller Transmissions in present equipment, do not attempt to replace a gear with one not made by Fuller because it will not "fit" perfectly. And, if you're thinking about new equipment, remember the importance of "shape" in transmission value, and insist on Fuller.

FULLER MANUFACTURING COMPANY, TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN
Unit Drop Forge Division, Milwaukee 1, Wisconsin



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project near Belem, Para Brazil, for the Division of Health and Sanitation of the office of the Coordinator of Inter-American Affairs. This project, near the mouth of the Amazon River, was constructed with native labor and without mechanical equipment. Mr. Swab is a graduate of Purdue University and was previously associated with the Sanitary District of Indianapolis, the Sanitary District of Chicago, the firm of Greeley and Hansen, and with William C. Olsen of Raleigh, N. C. He also served as city engineer of Altoona, Pa.

F. R. Johnson, engineer for Butler County, Iowa, since 1943, resigned recently because of ill health. He was employed by the state highway commission at Mason City, Ia., before he was county engineer.

J. G. McFadden, assistant Jasper County, Iowa, engineer, has been appointed Newton, Iowa, city engineer.

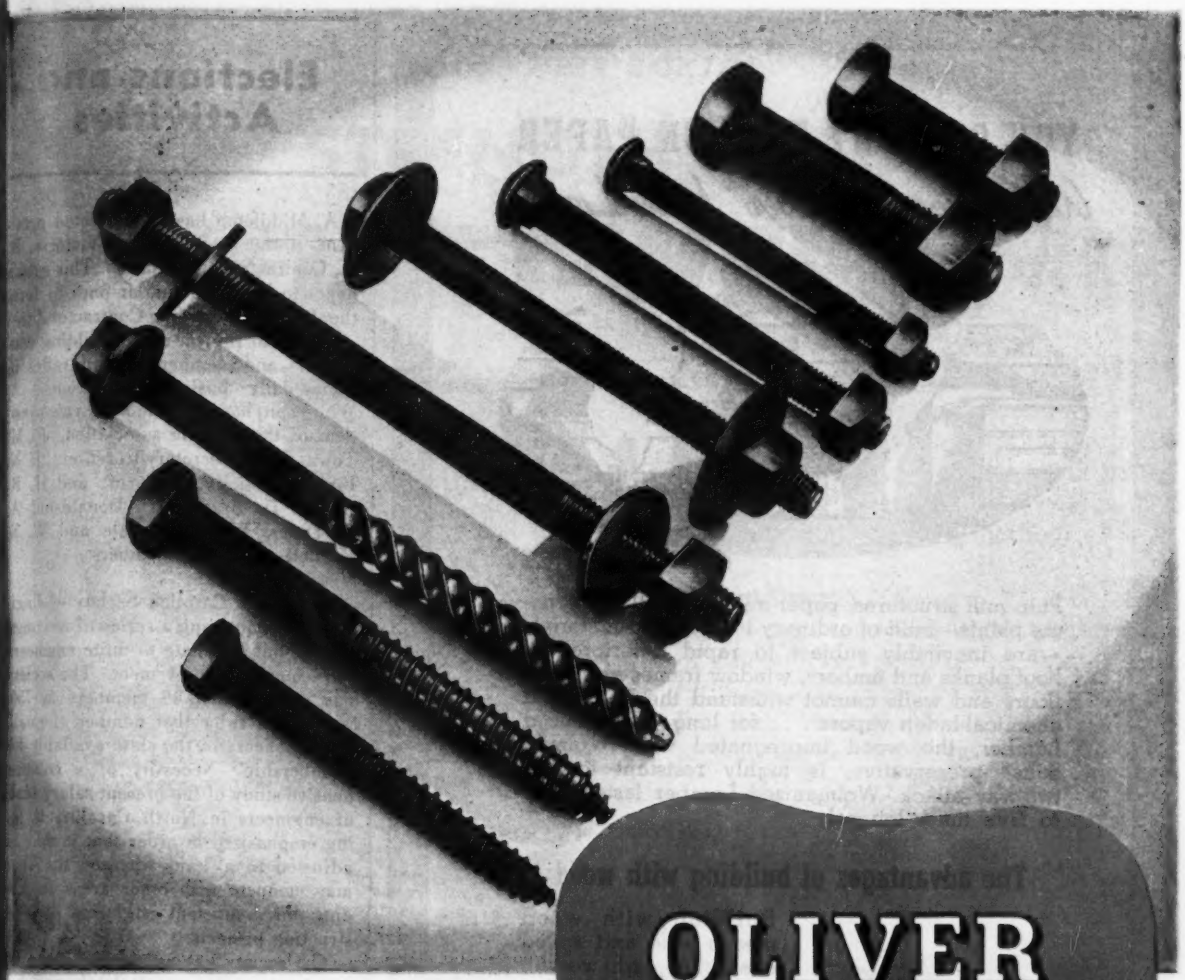
Carroll T. Sinclair has become chief engineer of the engineering and construction department, Duquesne Light Co., Pittsburgh, Pa. **Walter S. Church** has been made assistant general superintendent of construction. **Ralph B. Horner,** formerly design engineer, was named structural engineer, and **Fred J. Jernberg** assistant structural engineer.

Eugene N. Smith, who has been head of the city building inspection division of Wichita, Kan., for the last 11 years, has been made director of service, succeeding **P. L. Brockway** who becomes planning engineer for development of public improvement programs and operation schedules.

James Howland of Oregon City, Ore., has been promoted from captain to major in the Army. He studied engineering at Oregon State College, and received his master's degree from Massachusetts Institute of Technology. He entered the service in June, 1941, and has spent more than three years overseas. In October, 1944, he was given the Legion of Merit award.

Howard Minier has been appointed county road engineer by the Branch County, Mich., Road Commission. He is a former city engineer of Battle Creek.

Promotion of **Jed N. Robinson,** 192[illegible] graduate of A. & M. College, to be Austin district engineer for the Texas Highway Commission has been announced. He has been assistant district engineer at Tyler. He will succeed **Jim Douglas** transferred from the Austin to the Houston district of the Highway Commission. Robinson has been employed by the Texas Department for seventeen years



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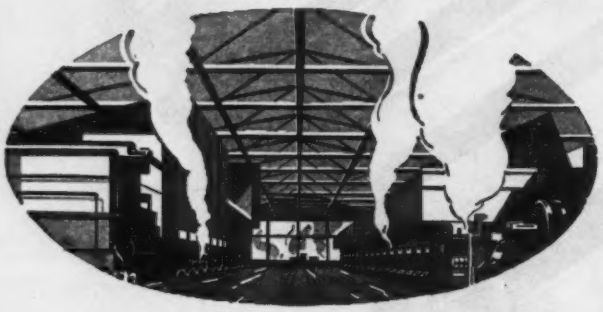

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Elections and Activities

A. Middleton has been elected president of the newly formed Victoria, B. C., Contractors' Association. This group hopes to join with similar ones to form the British Columbia Contractors' Association to protect small building contractors and members of sub-trades in their daily business operations. A. Whiteman has been named vice-president of the Victoria association. P. M. Townsend is secretary-treasurer; J. N. Finlay publicity chairman; and H. R. Brown, H. Bradley, D. Donaldson, A. E. Evans, W. J. Drysdale and W. S. Bartlett executive members.

The North Carolina Society of Engineers is sponsoring a series of meetings throughout the state to unite engineers for economic improvement. The society has grown from 49 members to 750, with about twice that number of qualified engineers in the state available for membership. Necessity of a comprehensive study of the present salary scale of engineers in North Carolina is being emphasized in order that it may be adjusted to a level whereby the state may compete with other areas in bidding for competent engineers on construction projects.

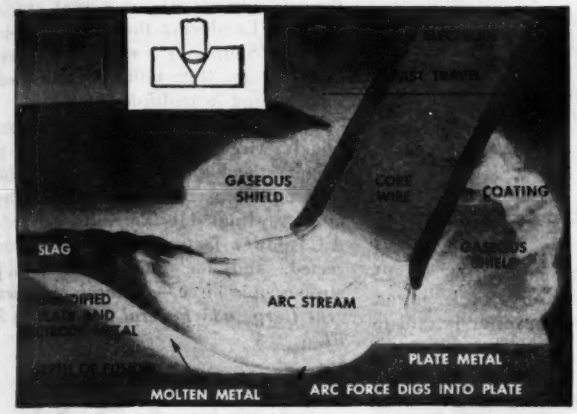
The society has announced plans for opening an office at Raleigh and has received from its nominating committee this slate of officers: T. P. Hewitt, Wilmington, president; William E. Henry, Charlotte and W. Paul Lyman, Raleigh, vice presidents; Withers Davis, Clinton, Martin Swartz, Greenville, Earl C. Dameron, Durham, T. B. Cunter, Raleigh, R. P. Reece, Winston-Salem, Neil Brown, Charlotte, Weldon Weir of Asheville and William F. Humbert, Spray, members of the board of directors.

The following officers have been elected for the Springfield Ill., Building and Construction Trade Council: Louis Rodier, president; G. B. Good, vice president; J. Earl Welch, secretary and treasurer; Charles Carey, sergeant at arms; and Karl Bitschenauer, Ernest Smith, and Frank Conway, trustees.

Col. Lynn C. Barnes, district Army engineer, has been elected president of Twin Cities chapter of Society of American Military Engineers. Other officers named at the organization's first meeting in three years are: Philip J. McCauley, Minn., state highway department, vice president, and Maj. Neil F. Kingsley, Minneapolis, secretary-treasurer.

LOOK, HERR DOKTOR, how to obtain

STRENGTH THROUGH "FLEET-WELDING"



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Competitive Strength. "Fleet-Welding" utilizes *arc force* to get higher travel speed and greater penetration with less deposited metal. For butt welds in 3/8" plate, speed is 350% higher; cost is 75% less than conventional method.

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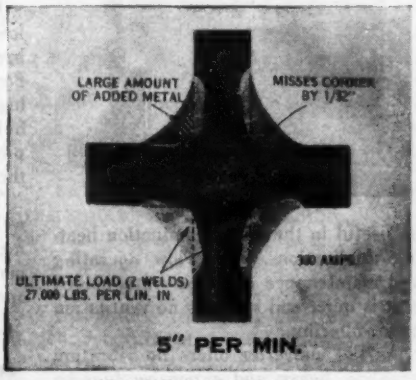
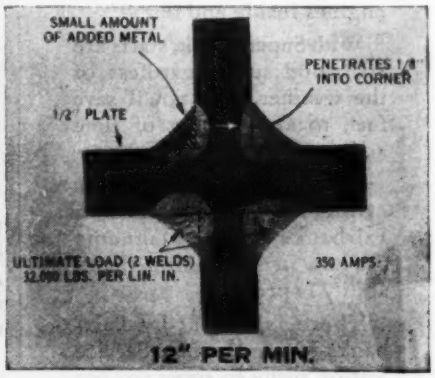
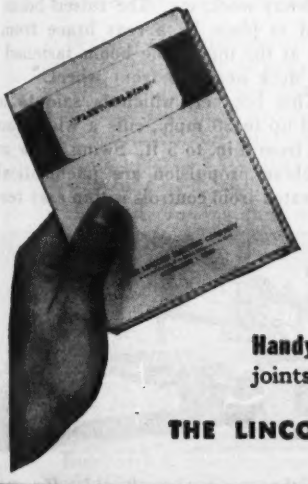


CONVENTIONAL TECHNIQUE


SMALL AMOUNT OF ADDED METAL
PENETRATES 1/8 INTO CORNER
1/2" PLATE
ULTIMATE LOAD (2 WELDS) 32,000 LBS. PER LIN. IN.
350 AMPS.
12" PER MIN.

"FLEET-WELDING"



Handy pocket manual, Bul. 444, gives "Fleet-Welding" procedures for all types of joints and welding positions. Free on request. Ask for it on your business letterhead.

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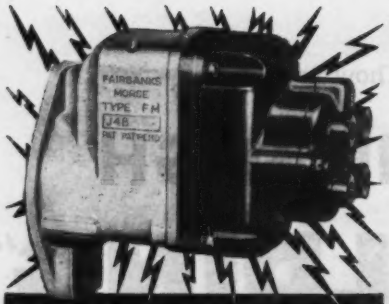

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New Aids to the Constructor

Lubricator

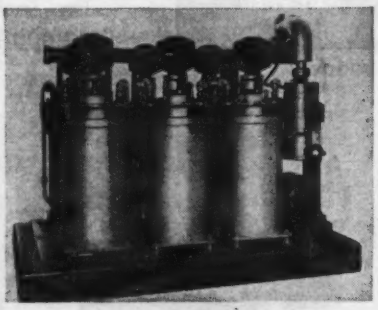
An ordinary grease container can readily be converted into a 25-lb. high pressure grease gun with the new Lincoln Handi-Luber, the manufacturer announces. This Model 1266 unit is a compact and sturdy grease pump, equipped with a 5-ft. hose assembly with hydraulic coupler for contacting all Kleenseal and hydraulic fittings.

The pump, manually operated, will dispense either light cup grease or viscous types, and can develop 5,000 psi. pressure.—*Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis 20, Mo.*

• • •

Mercury Arc Converter

Electronically changing power at commercial frequencies of 60 or 25 cycles into 1,000 to 2,000 cycle power, a new mercury arc converter is said to



be useful in the field of induction heating applications. With low operating and maintenance cost, the water-cooled unit is quiet and requires no ventilation or air-filtering.

As the converter offers no vibration problem, heavy and expensive foundations are unnecessary.—*Allis-Chalmers, Milwaukee, Wis.*

• • •

Masonry Cement

Developed after analysis of properties desired by masons under actual job conditions, a new masonry cement embodies six principal characteristics: plasticity; high water retention; strong bond; controlled setting time; water repellency; ability to hold color. This cement is said to exceed the requirements of Federal Specifications SS-C-18-lb. and A.S.T.M. Specification C91-44T.

Lone Star masonry cement is packed in multi-wall 70 lb., or 1 cu. ft., bags; it is shipped in carloads or in mixed cars with Lone Star portland cement and "Incor" 24-Hour cement.—*Lone Star Cement Corp., 342 Madison Ave., New York 17, N. Y.*

• • •

Cold Cathode Lamp

Instantaneous in starting, and with a life expectancy of 10,000 hours, the new "Colovolt" cold cathode fluorescent lamp is guaranteed for a year against failure. Employing the standard 93-in. lamps, "Simplicity" assemblies make available an 8-ft. unit, or continuous line lighting in multiples of 8 ft.

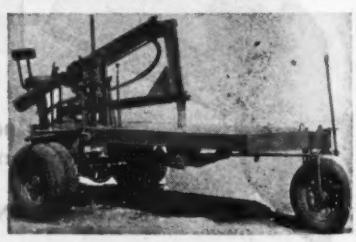
These assemblies are furnished completely wired, with ballasts, ready to mount; the bottom cover is removable for easy lamp replacement. The lamp operates from 110-125 volts, 60 cycle A.C. Power factor is 99 percent corrected, and the lamp is essentially stroboscopic free.—*General Luminescent Corp., 638 Federal St., Chicago 5, Ill.*

• • •

Pavement Breaker

Because of its ability to pass through low doors, a new three-wheel pavement breaker is adaptable to breaking out floors in addition to small patching on highway work, etc. The raised boom is held in place by a rear brace from a pin at the top of the boom fastened to the deck near the front wheel.

This breaker, which is said to tow well up to 50 mph., cuts a width ranging from 6 in. to 5 ft. Swing, blow and machine propulsion are pneumatically operated from controls within easy reach



of the operator.—*Rapid Pavement Breaker Co., 1517 Santa Fe Ave., Los Angeles 21, Calif.*

• • •

All-Position Electrode

Suitable for welding a wide variety of joints in all positions, a new shielded arc electrode, "Fleetweld 47", is said to have low spatter loss, easy slag removal and excellent re-striking characteristics, and to produce smooth, uni-

LET 'ER TRAVEL!

Materials move quickly... smoothly ... carried by flexible YELLOW STRAND *BRAIDED* SLINGS*

When a job's moving on schedule, it's costly to have it slowed by sling equipment. What you want—in factory, shop, warehouse or yard—is *flow* in the handling of sling loads. Yellow Strand *Braided* Safety Slings promote this smoothness. Their flexibility, kink-resistance and light weight enable operators to give each lift more accurate control . . . to run a series of pickups without wasted time or motion.

Patented *braiding* puts added limberness into long-wearing Yellow Strand Wire Rope. The sling conforms to odd shapes, grips curved objects firmly, takes thimbles, turnbuckles and other fittings readily. Weighing less than chain, *braided* slings are easily carried, fastened and detached, using a minimum crew. Employees welcome their security on big tonnage lifts, their Manila-like convenience for small jobs.

Yellow Strand *Braided* Slings are practicable for loads ranging from a 40-lb. drum to a 300-ton locomotive. Send details of your application now and let B&B engineers offer a recommendation.

Broderick & Bascom Rope Co., St. Louis 15, Mo. *Branches:* New York, Chicago, Houston, Portland, Seattle. *Factories:* St. Louis, Seattle, Peoria.

RIGGERS' HAND BOOK FREE
Shows sling types, fittings, capacities. Write for your copy.

*PATENTS: U.S., 1475088, 1824671, 2142541, 2142542, 2290068; CANADIAN, 393874, 2

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Yellow Strand
BRAIDED SAFETY SLINGS

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Sold by leading drawing material dealers everywhere
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form beads. Full penetration of ¼-in. plate can be obtained by welding one pass from each side.

This electrode, which may be used with alternating or direct current is available, in 50-lb. containers, in 5/32 x 14, 3/16 x 14, ¼ x 18, and 5/16 x 18-in. sizes.—*The Lincoln Electric Co., Cleveland 1, Ohio.*

• • •

Portable Supply Tank

Designed for use with the Wood Roadmixer, but adaptable to other traveling mixing plants and for any off-the-highway work, a new Wood portable supply tank carries road oils, emulsions or cut-backs; it can transfer or temporarily store practically any fluid. The

3,000-gal. tank is divided into 1,000 and 2,000 gal. compartments, and a 3-in. Roper pump, powered with either a Chrysler or Ford industrial engine, is mounted at the rear.

Tandem rear wheels are mounted on a walking beam and front wheels on a center pin. This, plus springless suspension, is said to eliminate twisting and torsional stresses, to keep load on an even keel and to distribute weight evenly.—*Wood Manufacturing Co., 816 W. 5th St., Los Angeles 13, Calif.*

• • •

Commercial Trucks

The WPB has authorized the manufacture of ten different models of commercial trucks, in a wide range of power ratings, gear ratios, wheelbase lengths and tonnage capacities.

One of the 1945 features in all heavy duty Federal models, 45M-60MA inclusive, will be the incorporation of a new and heavier steering gear mechanism with anti-friction knuckle bearings, which will assure easier steering with heavy loads. To be continued as standard equipment on all Federal trucks scheduled for production in 1945 will be the vacuum crankcase ventilating system. This system employs the engine vacuum to withdraw from the crankcase acid and sludge forming vapors at all engine speeds, thus preventing their accumulation in the crankcase and adding many miles to engine life. A combination of oil bath air

Build Well

Photo Courtesy H. H. Robertson Co. of Pittsburgh.

For Controlled Drainage

Z-120 ROOF DRAIN WITH INTEGRAL EXPANSION JOINT

Complete Specification Drain Catalog

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SPECIFY ZURN BUILDING, PLUMBING DRAINAGE SYSTEM ENGINEERING SERVICE

Clogged drains and improper or insufficient drainage facilities, allowing undrained water to run free, can decay, and destroy the best designed buildings. Specify Zurn for correct and complete plumbing drainage engineering and installation service.

Zurn Z-120 Roof Drain above is installed in a fabricated steel roof. Intregal expansion joint compensates for movement by the roof due to rain or snow loads, or expansion and contraction of drainage pipe lines. Eliminates leaks caused by torn or loose roof felts. Extra large non-clogging dome strainer insures rapid drainage at all times. Strainer-to-outlet open area ratio is from 3:1 (6" pipe) to 30:1 (2" pipe).

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The Zurn line includes drains for every service condition, and for all types of building material and construction.

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The EBERHARD FABER Drawing Pencil in 18 degrees, 7B to 9H — plus 6 degrees with special Chisel Point Leads

cleaner and oil filler which prevents the ventilating system from sucking dust-laden air into the crankcase will also be continued on all models.—*Federal Motor Truck Co., Detroit 9, Mich.*

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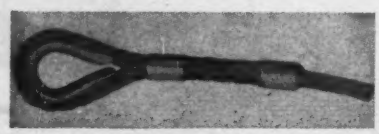
Safety Splice

A splice flexible to the terminal and developing the rope's full strength is said to be possible with the new Acco-Lok safety splice. With it, the rope



structure is not distorted, and stress is equal in all strands. The splice applies the load stress in a direct line with the pull of the load.

The splice is open for visual inspection at all times, and may be used with any standard hook, ring, shackle or thimble.—*American Chain & Cable Co., Bridgeport, Conn.*

• • •

Truck Loader

Capable of making a complete loading cycle every six seconds, the new 1 yd. capacity Jumbo truck loader is hydraulically operated. It operates with one lever from the cab, and all operations are in full view of the driver.

This loader, adaptable to many large and small road repair and clearing serv-

ices, snow removal, etc., is of rugged construction and may be used with any "cab over" or conventional truck. The shovel can be stopped in any position, and the shovel arms can be automatically locked into the body to add stability during spreading operations.—*Western Industrial Engineering Co., 3301 Medford St., Los Angeles 33, Calif.*

• • •

Hose Safety Valve

A simple, positive aid to eliminate dangerous whipping action when a high pressure air hose breaks or a connection fails is found in the new Aveco No. 1000 Limit-Flo safety valve, it is claimed. This valve closes the line when the flow of free air exceeds a predetermined amount.

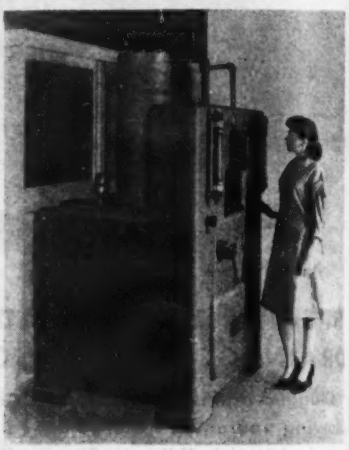
This valve, to be installed immediately above the upstream end of the supply hose, is available for several pressures and capacities.—*Associated Valve & Engineering Co., 510 North Dearborn St., Chicago 10, Ill.*

• • •

De-Ionization System

Raw water may be quickly converted into chemically pure water, meeting predetermined specifications, by the new Dorrco D-I de-ionization system, it is claimed. The unit regulates the exact degree of purity, softness and mineral content for specific uses. Use of silica-free exchange material makes possible long runs between regeneration.

Water is processed in two steps. The first stage passes raw water over a



bed of exchange material to remove calcium and magnesium constituents; sodium and other metallic salts can also be removed if desired. In the second step the anion exchanger absorbs the acid resulting from the initial step.—*The Dorr Co., Inc., 570 Lexington Ave., New York, N. Y.*

• • •

Cockroach-Repellent Cement

Incorporating finely divided copper in magnesium oxychloride cement provides a floor covering that has a lethal effect upon yeast, bacteria and molds, as well as a distinct repellency for cockroaches. This cement also can drain off static electricity, a safety factor not to be overlooked where inflammable materials or explosives are stored. This "Hubbelite" cement can be applied ⅜ to ½ in. thick on ordinary cement or wooden floors. Its adhesive properties are said to be excellent.

A floor treated with the cement can be used for traffic 24 hours after it has been laid, but its toxic properties are

SHOULD STEER LIKE PASSENGER CARS

Easy steering is just as important in trucks, buses, tractors, and road machines as in passenger cars and perhaps more so, for in most cases they are operated continuously for longer periods. The operator stays at the wheel of a commercial vehicle for hours at a stretch—and hard steering causes serious fatigue.

When equipped with Gemmer Steering these vehicles steer with an ease comparable to that of a passenger car. The fatiguing, heavy work is absent.

Design of the Gemmer Steering Gear is simple, sturdy. The hour glass worm—mounted on roller bearings—bears on gear teeth that roll—providing highest efficiency—smooth, easy transfer of power. Design banishes "lost motion" and minimizes wear. Steering is always firm, responsive, positive, with absence of rubbery feeling or wander. Maintenance is rarely, if ever, needed.

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TAYLOR Spiral Pipe, though remarkably light in weight, is a real champion in all around performance.

Many of its uses in the field are well recognized. Water lines over rough country, dredge lines, jobs where pipe is to be moved and changed, are some of the ideal applications for Taylor Spiral Pipe. So well does it serve on jobs of this kind that many construction men regard Taylor Spiral as special purpose pipe and are tempted to leave well enough alone.

But this "light heavyweight" in piping doesn't rest on its laurels — far from it! The economical way it handles the everyday run of piping jobs will make you want to switch to Taylor Spiral for nearly all moderate and low pressure services—services that ordinarily have been regarded as the stronghold of time-honored Standard Thickness pipe.

As for strength — the spiral seam in Taylor Pipe actually makes it stronger than any other type of pipe, size for size and gauge for gauge. This reinforcing seam gives Taylor Spiral Pipe greater bursting strength, greater collapsing strength, greater longitudinal stiffness than even a seamless pipe of equal wall thickness.

When you plan that next piping job consider using Taylor Spiral Pipe. The savings will be mighty worthwhile and the many jobs you will find for this economical piping may surprise you.

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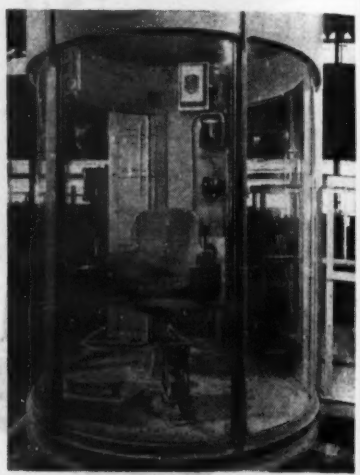
not present for a full three weeks, during which time no water may be applied.—Marketed through the *H. H. Robertson Co., Pittsburgh, Pa.*

• • •

Cylindrical Crane Cab

Full vision, comfortable seated control and air conditioning are incorporated in a new Model RPA cylindrical cab for overhead traveling cranes with magnetic control. It is 6 ft. 6 in. high and 4 ft. 6 in. dia.

Full length transparent panels are of a new shatterproof plastic, impervious to certain injurious gases. Master



switches are conveniently located; hoist and trolley switches are attached to the right and left arms of the chair and the bridge switch on the floor is controlled by the right foot. The air-cooled air conditioning unit provides fresh, clean air at any normal temperature, and the cab is well sealed and insulated. A traveling platform serves as a vestibule to the cab and gives access to the exterior for window washing.—*Cleveland Crane & Engineering Co., Wickliffe, Ohio.*

• • •

Cargo Crane

Said to be exceptionally maneuverable, a new Model YC-5 Cargocrane is one-man operated and supplied with abundant power. It can lift from 2,900 lb. at 15-ft. radius up to 15,000 lb. at 3½-ft. radius. The boom swings a full 210 deg.; the chassis has a short turning radius; the wheelbase is 10 ft. 9 in. The unit, so designed that the operator gets a clear view of the work from all angles, operates by a three-speed transmission from a 57 hp. gas engine.

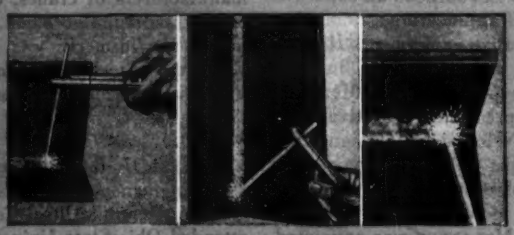
The goose-neck boom, 20 ft. long, can be furnished either in one piece or telescopic type.—*Link-Belt Speeder Corp., 307 North Michigan Ave., Chicago, Ill.*

SAYS THE MAN IN THE HELMET—

"Want an easy-working electrode? Then try this swell AIRCO No. 90...

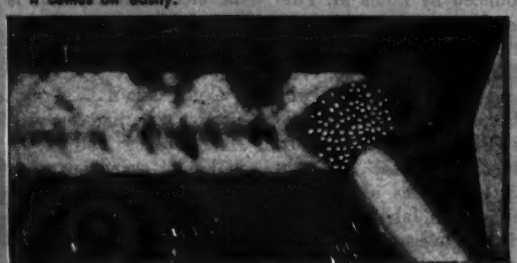
(AWS Classification E-6013)

"A kid can do a grand all-position job with this A.C. and D.C. electrode."



"It's a cinch to use in all positions and it produces fine-looking, uniform beads. Penetration is good but not too deep. That's why it's great for welding thin steel sections.

"Slag does not crowd the arc when welding in a vertical position from top to bottom. It gives ample coverage, yet it comes off easily.



"The arc has a forceful, spraying action which makes vertical and overhead welds easier. You can use plenty of current — either A.C. or D.C. — and the electrode won't deteriorate at the stub end.

"FOR WELDING LIGHT-GAUGE STEELS use Airco No. 90-A. It's a honey for welding chrome-moly and similar aircraft steels and it's made in 1/16", 5/64", and 3/32" sizes."

Airco No. 90 and No. 90A conform to requirements of AWS Classification E6013. For full details on Airco's complete line of electrodes for every welding need — get in touch with your local Airco office and have them send you a free copy of Catalog No. 120. If you wish, address your request to the New York office, Dept. EN.

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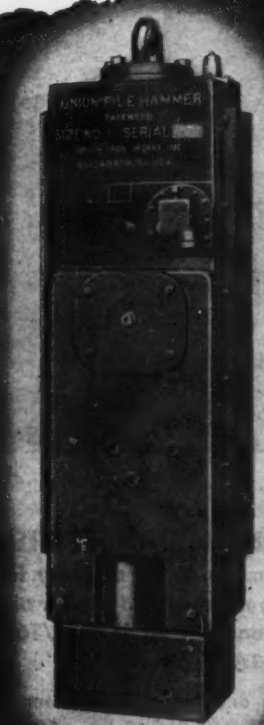
Weld with

AIRCO ELECTRODES FOR BETTER WELDS AND EASIER WELDING

The PILE HAMMER
that seeks Perfection



A perfectly-designed pile hammer should be sturdy and durable, have parts that are simple, accessible and few in number, and should have an effective means of lubrication. Write for bulletin No. 184 and check Union specifications.

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Manufacturers' Activities

IN ORDER to enable R. G. LeTourneau to devote more time to research and engineering activities, R. G. LeTourneau, Inc., Peoria, Ill., announces the addition of Robert F. Nelson to its executive staff as vice-president and assistant to the president. Mr. Nelson, former vice president and director of the Arma Corp., Brooklyn, N. Y., takes to LeTourneau an extensive background of engineering, production and administrative experience. He will work closely with Denn. M. Burgess, executive vice-president, and Merle R. Yontz, vice president and treasurer. One of Mr. Nelson's first assignments will be to assist in establishing a new LeTourneau plant in England this Fall.

HARVEY A. MYLANDER was appointed recently Pacific Coast manager for the American Hoist and Derrick Co. of St. Paul, Minn. A graduate of the University of Arizona, with many years experience in the heavy equipment field, he will be in charge of the company's offices in the Russ Building, San Francisco.

THE APPOINTMENT of W. O. Lawrence as plant manager of the Leeds, Ala., plant of the Universal Atlas Cement Co., United States Steel Corp. subsidiary, has been announced by Louis M. Funderburg, general operating manager. Mr. Lawrence has been acting manager of the Leeds Plant since March 16, 1945, when he succeeded John P. Camm who at that time became plant manager of the company's Osborn, Ohio, plant. Mr. Lawrence joined Universal Atlas at Leeds in 1933, serving as operator in the burning department, laboratory technician, clerk in the operating and construction departments, and as draftsman. He spent two years at the New York office as a field engineer, and returned to Leeds in 1942 as assistant plant manager.

THE CELOTEX CORP., Chicago, Ill., has announced that lightweight celocrete aggregate will be manufactured in a recently opened government-owned plant at South Chicago, Ill. Production is expected to begin at once.

The plant is operated by the Republic Steel Corp. and is well situated to take care of an increasing demand for lightweight aggregate for concrete construction in the midwest states. It is said to be the largest plant of its kind in the United States.

RALPH S. SIEGRIST has joined The Commercial Shearing & Stamping Co., Youngstown, Ohio, as salesman for tunnel supports. Mr. Siegrist was formerly with Hercules Powder Co. as explosives engineer and salesman.

J. S. MURRAY has been appointed Pittsburgh district manager for the Alliance Machine Co., Alliance, Ohio, manufacturers of cranes, charging machines and similar steel plant equipment. He formerly was engineer for Follansbee Steel Corp, Follansbee, W. Va., where he has been employed since 1909.

FORREST H. RAMAGE has been made assistant manager of sales of the pipe division, Republic Steel Corp. Ramage attended Ohio State University and was graduated from Michigan College of Mining and Technology in 1924, with the degrees of B.S. and E.M. He joined Republic Iron & Steel Co. as metallurgist in 1926.

A. S. HAAGMAN has resigned from Foster-Wheeler Corp. and is now connected with Simon Holland & Son, Inc., steel fabricators, Brooklyn, N. Y. in charge of sales. Mr. Haagman, a former executive of Easton Structural Steel Co., has been long connected with the steel industry and is returning to that field to prepare for postwar construction.

COL. JOSEPH P. WOODLOCK has been elected executive vice-president of Rochester Ropes and will take over his duties as soon as he can be released from his present assignment as associate director of the Office of Surplus Property in the Reconstruction Finance Corporation. Formerly he was executive officer under W. L. Clayton in the Surplus War Property Administration, having been detailed from the Army to that assignment by Lt. Gen. Lucius D. Clay.

Colonel Woodlock entered the Army shortly after Pearl Harbor, resigning his position as director of warehouses

We build all 4 Material Handling Buckets

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ALL PURPOSE

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- PULLSHOVEL
- DRAGLINE
- CLAMSHELL

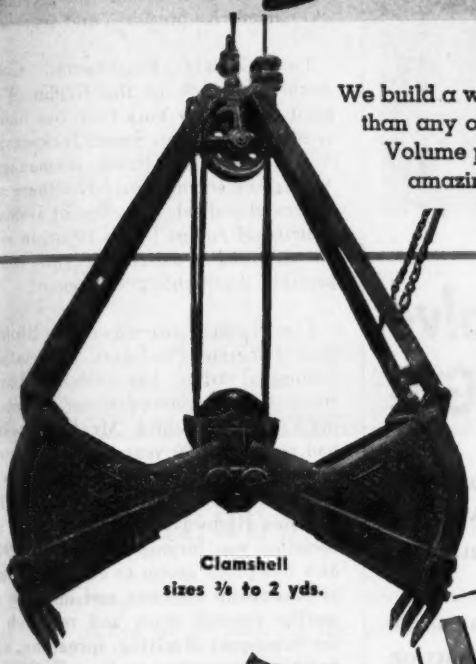
See your shovel engineer or equipment dealer about PMCO Rippers and buckets.

AMERICA'S MOST COMPLETE LINE OF MATERIAL HANDLING BUCKETS

We build a wider and more complete line of material handling buckets than any other manufacturer.

Volume production methods enable us to build a better bucket with amazing economies in manufacturing.

. . . Experience Counts . . .



Clamshell
sizes ⅜ to 2 yds.

Pullshovel
sizes ⅜ and ¾ yd.

● On the ½ yd. and ¾ yd. sizes of Shovel, Pullshovel, and Dragline Buckets, all teeth are interchangeable . . . a great convenience to operators.

Shovel
sizes ⅜ to 18 yds.

Dragline
sizes ⅜, ½, ¾, 1, 1½, 2, 2½ yds.

WE CONDUCT THE LARGEST AND MOST COMPLETE MANGANESE STEEL FOUNDRY IN THE UNITED STATES

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4700 West Division Street, Chicago 51, Illinois

This new CLAYTON Check Valve positively prevents SURGE!

SURGEMASTER provides no-surge, no-slam control.

At last . . . the Check Valve that provides *controlled* surge protection. The Clayton HYDROMATIC Check Valve is entirely hydraulic in operation. It cannot slam. It positively prevents surge.

The HYDROMATIC Check Valve operates like a hydraulic door closer. In closing, the final action is throttled, thus effectively preventing surge. The opening operation is similarly controlled. Action in either direction starts by equalizing pressures gradually, without shock or water hammer.

Pressure to open and close the valve is directed through the SURGEMASTER Control which is adjustable to permit changing the speed of opening and closing to meet all conditions.

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VALVE DIVISION
CLAYTON
"Feather Touch" CONTROL

CLAYTON MANUFACTURING COMPANY, ALHAMBRA, CALIFORNIA

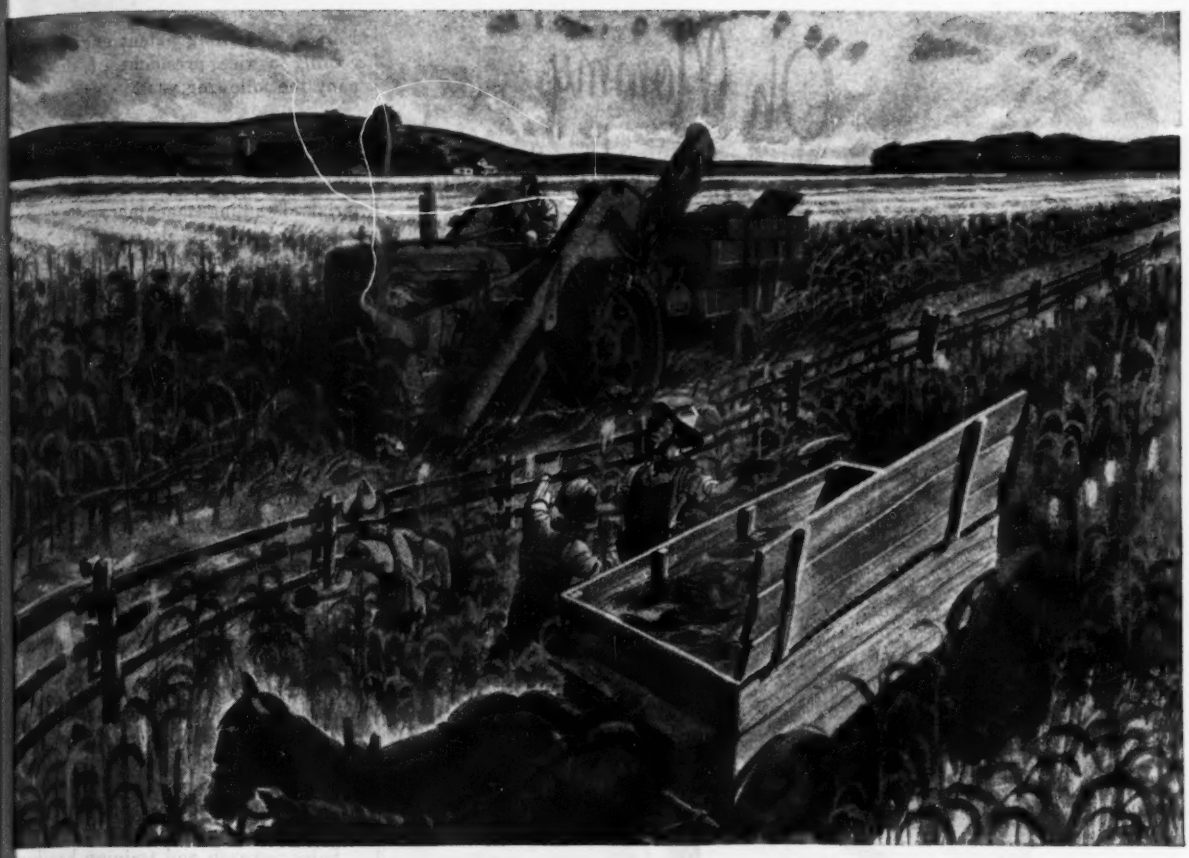
for the Crucible Steel Co., New York. Prior to that for eleven years he was assistant to the vice-president in charge of marketing, B. F. Goodrich Co., Akron, Ohio. Colonel Woodlock will make his headquarters in Culpeper, Va., where are the company's executive offices and its principal manufacturing operations.

WALTER A. RENTSCHLER, vice-president and secretary of the General Machinery Corp., Hamilton, Ohio, has been elected vice-president and treasurer, succeeding the late Col. Sidney Waldon. J. E. Peterson, a former vice-president, was named vice-president and secretary.

THE GRIFFIN ENGINEERING CORP., southern branch of the Griffin Wellpoint Corp., New York City, has moved to 2016 East Adams Street, Jacksonville 2, Fla. Neill N. Payne is manager. Among the services rendered there are the rental and sale of wellpoint systems, centrifugal pumps 1½ to 10 in. in size, portable engine-driven generators and portable floodlighting equipment.

THE BOARD of directors of the Bituminous Concrete Producers Association, Columbus, Ohio, has selected Lloyd Burgess as engineer-director, succeeding Fred E. Swineford. Mr. Burgess has had more than 20 years of highway experience. He served for several years as assistant to the bituminous engineer for the Ohio Highway Department. The association was formed in August, 1943, as a non-profit group to extend the use of bituminous concrete and improve its quality through study and research of the techniques of mixing, spreading, and finishing, according to Guy F. Atkins, executive secretary.

W. O. BATES, JR., vice president of Caterpillar Tractor Co., Peoria, Ill., has moved to San Leandro, Calif., to assume full-time administrative responsibilities as manager of the company's offices and plant there. A native of Joliet, Ill., Mr. Bates is a pioneer in the track-type tractor industry with which he has been affiliated almost continuously since he entered the employ of the Bates Machine and Tractor Co. in 1912 upon graduation from Cornell University. He was connected with the Bates Co. until 1935. Following two years during which he was in business for himself as a consulting engineer, Mr. Bates joined the Caterpillar Tractor Co. in



THERE'S BEEN A BIG CHANGE

★ Just try to persuade the owner of a modern mechanical corn picker to go back to the old hand-picking methods.

And try to induce an operator of heavy-duty equipment to return to ordinary tapered roller bearings, once he has used Tyson . . .

Yes, there's been tremendous improvement in bearings. Tyson found the way to add 30% more load-carrying rollers around the raceway. Result: (1) Extra capacity, (2) maximum rigidity, (3) longer life. Most users report double the life of ordinary bearings.

Tyson "All-Rolls" Bearings are interchangeable with other tapered roller bearings. Part numbers and prices are the same. Next time, use Tyson.

TYSON BEARING CORPORATION · MASSILLON, OHIO

COUNT THE ROLLS · THE ROLLS COUNT

Tyson

THE LAST WORD IN ANTI-FRICTIONEERING

No Idle Home Equipment When Repair Parts Come by AIR EXPRESS

Empty spaces on retailers' shelves or shortages of repair parts do not always mean that merchandise is not to be had. Often it's merely a matter of ordering a little at a time.

This is where Air Express steps in. It speeds merchandise to those shelves—even if in small amounts — so that customers do not have to be turned away or told that their household equipment cannot be repaired for weeks. It brings the spare parts stocks of the nation within but a few hours of retail stores. Very often, Air Express means next day delivery.

And not only does the speed of Air Express meet emergency needs in the retail trade, it puts suppliers' stocks so near at hand that it often means greatly reduced inventory and, therefore, faster rate of turnover.

Specify Air Express-a Good Business Buy

Shipments travel at a speed of three miles a minute between principal U. S. towns and cities, with cost including special pick-up and delivery. Same-day delivery between many airport towns and cities. Rapid air-rail service to 23,000 off-airline points in the U. S. Service direct by air to and from scores of foreign countries.

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Write Today for interesting "Map of Post-war Town" picturing advantages of Air Express to community, business and industry. Air Express Division, Railway Express Agency, 230 Park Avenue, New York 17. Or ask for it at any Airline or Express office.

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1937 as consulting patent engineer, becoming a vice president of the company the following year.

IN PREPARATION for more intensive sales activity, Robins Conveyors Inc., Passaic, N. J., manufacturers of materials handling machinery, has reorganized its sales department, which continues under the direction of Harold Von Thaden, first vice-president.

Under the new plan, E. C. Salzman, vice-president, formerly in charge of sales, assumes responsibility for all export operations, including dealings with foreign affiliates and agents. Mr. Salzman's headquarters will be located at the 70 Pine St., New York City, offices of the company.

Moving to Passaic from the Chicago office, which was under his charge, J. F. Meissner, vice-president, takes over control of all engineering sales and of the field engineers who devote their attention solely to designing and engineering materials handling projects and plants.

The equipment sales section is now under A. E. Conover, formerly manager of the vibrating machinery division. His responsibilities include the direction of the field engineering staff concerned with the sale of equipment, where little or no engineering is involved.

Sales research and training has been put under T. W. Matchett, secretary of Robins Conveyors Inc.; advertising and sales promotion remain under E. M. Perrin; the engineering dept. continues to be headed by R. W. Eichenberger, vice-president.

HENRY BARNHART, formerly manager of the shovel and crane division of Lima Locomotive Works, Lima, Ohio, has been named vice president in charge of that division. He joined the sales force in 1928 as assistant sales manager. In 1936 he was made general sales manager of the shovel and crane division, and in 1943 he became manager of the division.

ALBERT JAY TOWNSEND, chief mechanical engineer has been appointed vice president in charge of engineering. He received engineering training at the University of Michigan. He joined Lima in 1917 as calculator, and has served successively as chief calculator, mechanical engineer and chief mechanical engineer.

THE JOHN N. THORP CO., 50 Church Street, New York City, has been formed by Jack Thorp as a distributor agency for well-known lines of construction equipment, machinery and railway supplies. Several prominent manufacturers have already selected the company to represent their lines in New York and

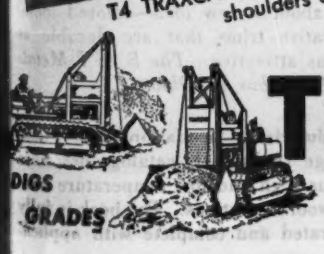
PLAN FOR BETTER EQUIPMENT, TOO!

Big 2½ yard T7 TRAXCAVATOR grading new street in San Francisco

Loading sand at Portland, Maine . . . one of many tasks for this city's TRAXCAVATOR

T4 TRAXCAVATOR loading excess dirt from shoulders on an Indiana road job

WHEN the "go-ahead" signal is given, your well-planned construction projects will get off to a flying start if you have planned to "TRAXCAVATE" — for it's the modern earth-moving and material-handling method. TRAXCAVATORS, the dependable tractor excavators, combine in one machine the usefulness of a shovel, loader, scraper, bulldozer, anglegrader, etc. There's a size for every job and purpose. Your TRACKSON-"Caterpillar" dealer will be glad to give you the complete and revealing story, or write to the TRACKSON COMPANY, Dept. ENR-75, Milwaukee 1, Wisconsin



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THE ORIGINAL TRACTOR EXCAVATOR

LOADS CARRIES

A SAFETY HOOK
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EASY TO USE
as a risky one

Since Laughlin's newly-designed latch provides approximately 80% of the throat opening of ordinary hoist hooks, more and more materials handlers are swinging over to the safe side.

You, too, can add safety to efficiency by making loads jolt-proof. Investigate these rugged, drop-forged, heat-treated, standard-type hoist hooks with sturdy latches and stainless steel springs (½ to 15 ton safe load).

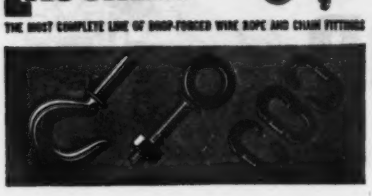
THE LAUGHLIN HOOK LINE

Laughlin has the most complete line of hooks: grab hooks, hoist hooks, cargo hooks and others. All are heat-treated, drop-forged and weldless.

Distributed through mill, mine, and oil field supply houses. For catalog, write Dept. 2, The Thomas Laughlin Company, Portland 6, Maine.

LAUGHLIN

THE MOST COMPLETE LINE OF DROP-FORGED WIRE ROPE AND CHAIN FITTINGS



vicinity. Mr. Thorp is well known among distributors of contractor's equipment and railroad supplies, having been manager of the construction equipment division of the Chicago Pneumatic Tool Co., for eight years, and prior to that, he spent twelve years as special representative of Ingersoll-Rand Co., in the railroad and construction department.

Following his service in World War 1 as major, airplane pilot, U. S. Army, Mr. Thorp entered the field of railroad and construction as transitman on the engineer corps of the Erie Railroad Co., later being promoted to track supervisor of the Greenwood Lake division and Newark Branch, and still later to special representative of the general manager.

HERBERT P. MEE, a former vice-president of Caterpillar Tractor Co., Peoria, Ill., died recently in Santa Barbara, Calif. He joined the C. L. Best Tractor Co. in 1920 as credit manager and when that company and the Holt Mfg. Co. merged in 1925 to form Caterpillar Tractor Co., he became treasurer. Two years later he was appointed vice president and treasurer, and in 1934 was made vice president of sales, later taking over the additional administration of advertising and service. He had been retired since 1937.

THE CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio, announces a new heavy machine division with headquarters in Wickliffe. The division will be responsible for the sales of heavy Cleveland overhead traveling cranes and Steelweld bending presses, bulldozers and special machinery.

C. H. Saiter

Charles H. Saiter has been appointed sales manager in charge of the division. He was sales manager of the former heavy crane department and has been with the company for 23 years in various engineering and sales capacities.

R. G. ADAMS has been promoted to assistant district sales manager of the Pennsylvania-Dixie Cement Corp. with headquarters at Rhodes-Haverty Building, Atlanta, Ga.

NEW ASSIGNMENTS of Portland Cement Association staff have been announced. M. J. McMillan, manager of the Washington office since 1936, becomes regional manager of the Eastern offices, 347 Madison Ave., New York.

Manufacturers' Publications

Lubrication Guide for Contractors—The second edition of the Gulf "Lubrication and Maintenance Guide for Contractors' Equipment" is a 72-page book which contains a wealth of information on a very important subject. The chapters are included on engine lubrication, care of air cleaners, oil filters, carburetors, valves, transmission, hydraulic systems, bearings, pumps, batteries, tires, etc. Perhaps the most valuable feature is a general lubrication chart.—*Gulf Oil Corp., Gulf Building, Pittsburgh, Pa.*

Earth-moving—A new 16-page booklet "There's Work to be Done," illustrates numerous jobs previously done by the earthmoving contractor and it also gives an indication of big jobs that lie ahead.—*Caterpillar Tractor Co., Peoria 8, Ill.*

Sewage Treatment and Disposal—A 20-page edition of the bulletin, "Measurement, Control and Chemical Treatment of Sewage and Sludge", has been prepared for engineers and others engaged on sewage treatment problems and plant layouts for both large and small communities. It contains descriptions of chemical feeders and new types of indicating, recording and integrating flow instruments. Useful reference diagrams are also included.—*Builders-Providence, Inc., 9 Codding St., Providence 1, R. I.*

Automatic Centrifugal Pumps—This books contains color illustrations of each model, and complete details of the applications of each pump, as well as performance tables. Four pages are devoted to special construction features of automatic centrifugal pumps. It has complete catalog specifications and the last section covers information on "How to Select the Right Pump for the Job."—*Barnes Manufacturing Co., Mansfield, Ohio.*

Colored Metal Trim—A circular tells about a new idea—colored metal decorative trims that are durable as well as attractive.—*The B & T Metals Co., Columbus 16, Ohio.*

Industrial Insulations—A new, 28-page industrial catalog describes various high and low temperature mineral wool insulations. The book is fully illustrated and complete with applica-

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tion specifications, conductivity curves and engineering data.—*Baldwin-Hill Co., 544 Klagg Avenue, Trenton 2, N. J.*

Jack Maintenance Manual—Users of lever and hydraulic jacks will find practical help on maintenance and care in a new 48-page catalog. The repair parts for the various types and sizes of jacks are illustrated and listed. The types of jacks covered include automatic lowering, mine timbering, car siding, geared cable reel, cable tensioning, pole pulling, mine post pulling, pull rod, track, pipe pulling and pushing, journal, rail pulling and expanding, push and pull, mine roof and hydraulic jocks.—*Kenly & Co., 1020 S. Central Ave., Chicago 44, Ill.*

Corrugated Steel Sheet Piling—An illustrated bulletin shows how this piling is being used for such work as soil erosion prevention, flood control, gully check dams, sea and dock walls and flood protection walls.—*Caine Steel Co., 1820 North Central Ave., Chicago 39, Ill.*

Truck Leasing—A brochure outlines the advantages of truck leasing rather than truck ownership as follows: Saving executives' time; costs known in advance; elimination of maintenance worries; release of capital invested in trucks; and well-maintained delivery equipment.—*National Truck Leasing System, 540 North Michigan Ave., Chicago 11, Ill.*

Care of Tires—A 48-page booklet on "How to Get the Most Service Out of Your Off-the-Road Tires" has been published.

In this booklet are 17 pages devoted to preventive maintenance. Among subjects are: "How Load, Inflation and Operating Conditions Affect Tire Cost," "Effects of Overloading," "Overinflation", and "Underinflation," "Bleeding Tires," "Care of Valves," "Haulage Roads," "Road Maintenance," "Hazard Areas," "Tire Clearance," and "Effects of Water."

Four pages are given to recommended speeds and tire loads at various inflation pressures for each size and type of tire, while three are devoted to sizes, loads and dimensions of each tire.—*The B. F. Goodrich Company, Akron, Ohio.*

Lathes—This catalog illustrates an entire series of lathes in full color and gives complete specifications of each model. Lathe tools, accessories, motors and controls, and attachments for special classes of work are also included.—*South Bend Lathe Works, South Bend 22, Ind.*

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